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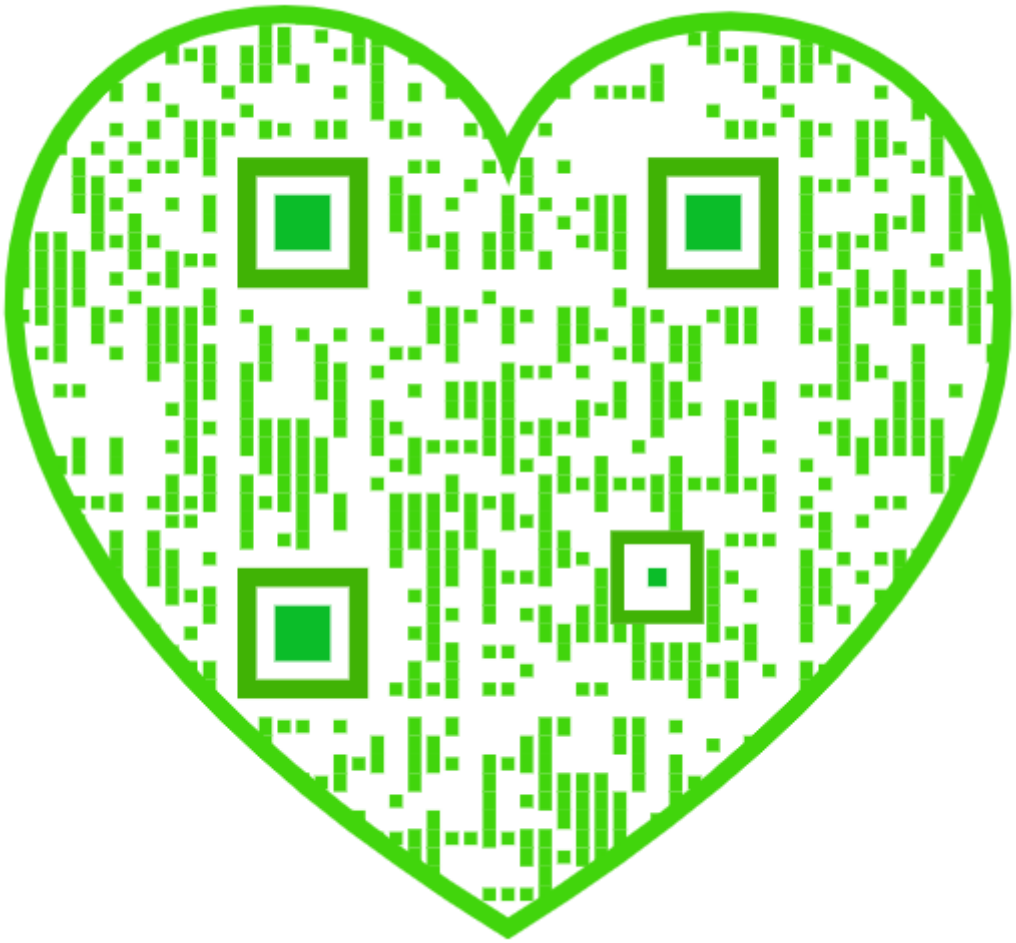

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Who should attend:
All those with an interest in the Aerospace, Aviation and Space communities. We are pleased to welcome both RAeS members and non members to the event.

Guest of Honour
Dr. Brendan Nelson AO
Senior Vice President, The Boeing Company
President, Boeing Global

Book now for this flagship event - scan the QR code on the right or visit **www.aerosociety.com/banquet** to find out more.

AEROSPACE

Volume 52 Number 2
February 2025

EDITORIAL

Manifest destiny on Mars

On 13 September 1962, the whole of NASA woke up with an asteroid sized hangover after the previous day when President John F Kennedy had publicly committed the US to go to the Moon – "by the end of this decade". After only just scraping into space with Mercury, there must have been many who were questioning JFK's sanity to promise such a seemingly impossible goal.

Similar feelings may have swept around the agency on 20 January when newly inaugurated Donald J Trump, promised "American flags and boots on Mars" – much to the delight of Elon Musk – and throwing a curveball into US plans to return to the Moon with the Artemis programme.

It must also be remembered that it was Trump's first administration that supercharged Artemis, after previous US dithering over the Moon or Mars. He is in the rare position of a president who would be in office during his second term to see his goal of a Lunar landing he set motion take place.

Now, however, the goalposts for US human spaceflight have changed once again – and an even more ambitious goal set forth. What this means then, for Artemis is still unclear. Will it be axed completely, or scaled back? Can the US afford go to both the Moon and Mars? How will a mission to Mars be funded? Will international partners be needed? Of course, one difference between the 1960s and today is that spaceflight is now accelerated by the private sector. Unleashing this massive potential with a clear, long-term goal is the way forward.

While some may profoundly disagree with Trump's America First politics, there is no doubt that putting a human on Mars is the next great challenge in space. It is noteworthy that, even today, Apollo is seen as not just a US endeavour, but one that all humanity shares in. As a species that is constantly looking up, 'manifest destiny' in space is not just an American dream, but one that should excite and inspire us all.

Tim Robinson FRAeS, Editor-in-Chief
tim.robinson@aerosociety.com @RAeSTimR

Correspondence on all aerospace matters is welcome at: **publications@aerosociety.com**

Editor-in-Chief
Tim Robinson FRAeS
+44 (0)20 7670 4353
tim.robinson@aerosociety.com

Deputy Editor
Stephen Bridgewater FRAeS
+44 (0)20 7670 4351
stephen.bridgewater@aerosociety.com

Features Editor
Jack Richardson
+44 (0)20 7670 4352
jack.richardson@aerosociety.com

Production Manager
Wayne J Davis FRAeS
+44 (0)20 7670 4354
wayne.davis@aerosociety.com

Production Executive
Annabel Hallam
+44 (0)20 7670 4361
annabel.hallam@aerosociety.com

Book Review Editor
Tony Pilmer FRAeS
book.reviews@aerosociety.com

Editorial Office
Royal Aeronautical Society
No.4 Hamilton Place
London W1J 7BQ, UK
+44 (0)20 7670 4300
publications@aerosociety.com
www.aerosociety.com

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Chief Executive
David Edwards FRAeS

Advertising
+44 (0)20 7670 4346
partners@aerosociety.com

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Wayne J Davis
+44 (0)20 7670 4354
aerosubs@aerosociety.com

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Front cover: Is the public ready for single-pilot operations? (Wayne J Davis/RAeS)

AEROSPACE INSIGHT

Additional content is available to view online at: aerosociety.com/aerospaceinsight
Including: Boxing clever? China's next-gen tailless combat aircraft analysed, Could the next big environmental problem come from space? Regaining control, Plane Speaking – UK Space Agency Director of Launch, Blue Origin goes orbital.

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TABBIES 2024 Award Winner

AEROSPACE APP

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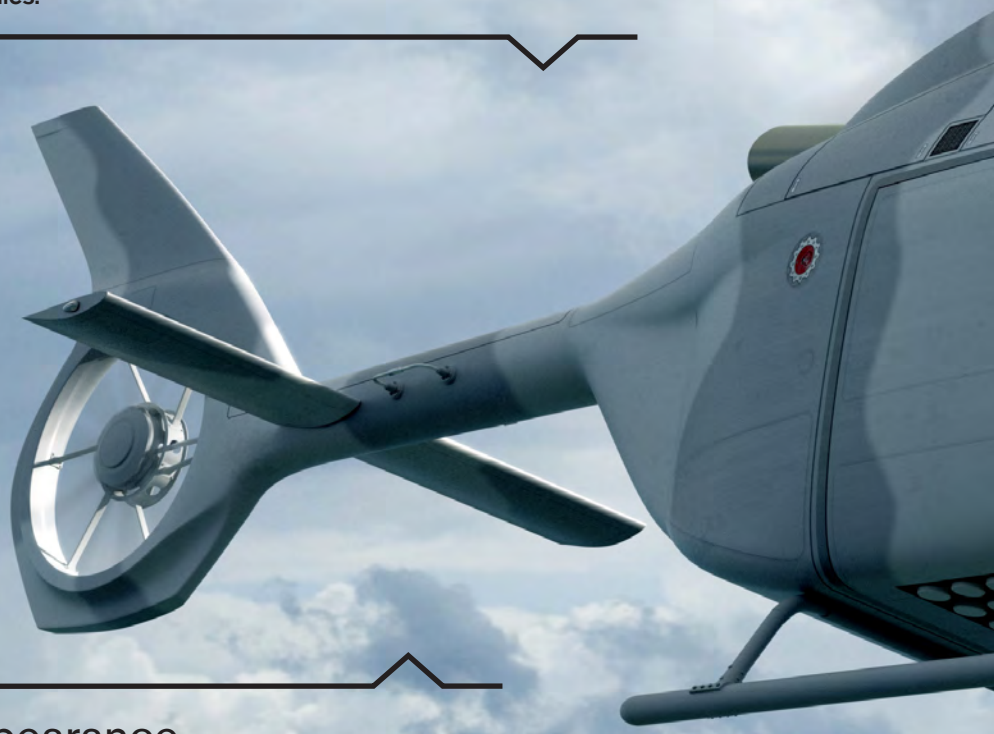
Blueprint

Modular payload

The aircraft has been designed with a multirole capability in mind by virtue of its modular payload bay. Roles depicted include anti-submarine warfare (with both a dipping sonar and acoustic sonar buoys), airborne early warning, cargo/resupply, an extra fuel tank to increase endurance and potentially weapons, such as torpedoes and missiles.



Evolving appearance

Since an initial concept was released at DSEI 2023, the appearance of Proteus has changed to include an enclosed tail rotor and a skid landing gear. The latter deviates from current Royal Navy practice with helicopter landing gears because the service's crewed designs all utilise a wheeled gear system.

DEFENCE

Proteus breaks cover

Leonardo, along with the Royal Navy and the UK MoD's Defence Equipment and Support (DE&S) Future Capability Innovation team, unveiled the design of the Proteus technology demonstrator helicopter on 7 January. The large uncrewed helicopter will explore "autonomy, payload modularity and interchangeability" and be developed using digital twin technology. According to Leonardo, more than 40 components will be manufactured with advanced composite materials and AI will be used in its control software. First flight is slated for mid-2025.

Future-proofing

Leonardo is keen to stress the future options available with this platform, including the potential to include hybrid propulsion and the ability to co-operate with crewed assets, as well as exportability.

Digital twin

The demonstrator was perfected by Leonardo using a digital twin with artificial intelligence and machine learning utilised to conduct tests without the use of a physical aircraft. The company has also taken advantage of advance manufacturing techniques such as additive manufacturing.

Swiss origins

Proteus is based on the Kopter SH09, a light helicopter design produced by Swiss firm, Kopter and marketed as the AW09, after Leonardo acquired Kopter in 2020.

Radome

DEFENCE

Stealth surprises from China

Chinese Internet

Video and photographs of two previously unknown Chinese stealth aircraft surfaced on social media on 26 December. A large tailless combat platform (top left) was shown flying from Chengdu's Wenjiang factory airfield in daylight. The aircraft was escorted by a Chengdu twin-seat J-20S. Later in the day, images were released showing a smaller aircraft (top right) – seemingly from the Shenyang Aircraft Design Institute – flying in company with a Shenyang J-16 chase aircraft. The new type appears to be a tailless arrow-winged fighter with two engines.

AIR TRANSPORT

Airliner order backlog reaches record 17,000

A report issued by IATA in December confirmed that ongoing supply chain issues and production cuts at Boeing in 2024 have resulted in the order backlog for new airliners reaching a record level of 17,000 airframes. The past year saw 1,254 aircraft deliveries – some 30% lower than predicted and down from a peak of 1,813 in 2018. Furthermore, IATA says that 2% of the current global fleet is parked for engine inspections and "severe supply chain issues" are expected to continue to affect the sector throughout 2025. The organisation has adjusted its forecasts for the year ahead down from 2,292 deliveries to just 1,802 but warned that "further downward revisions [are] widely seen as quite possible."

AEROSPACE

Azerbaijan Airlines E190 in shoot-down incident

On Christmas Day, an Azerbaijan Airlines Embraer E190 crashed near Aktau in Kazakhstan, killing 38 of the 67 passengers and crew on board. The jet had been flying to Baku, Azerbaijan to Grozny, Russia but, after two attempts to land in fog, an explosion was reported and it was diverted across the Caspian Sea to Aktau. Tragically, the aircraft crashed a few miles short of Aktau's runway. Grozny had been under attack by Ukrainian drones shortly before the flight and Ukraine announced that the aircraft had been struck by a SAM. Passenger video from inside the aircraft appears to show shrapnel holes and external images of the crash show damage consistent with an explosion near the tail.

SPACEFLIGHT

Blue Origin thunders into orbit

Blue Origin

On 16 January, Blue Origin successfully launched its heavy-lift reusable New Glenn rocket on its first mission, becoming the first private space company in the Western world to reach orbit on its initial attempt. Launched from Cape Canaveral, Florida, New Glenn's payload for the first flight was the Blue Ring space tug. However, the GS-1 reusable first stage of the rocket was lost on descent and not recovered to the landing ship as planned. Blue Origin has already received contracts from NASA, the US Space Force and Amazon for its New Glenn launcher. An FAA investigation is now under way on the loss of the first stage.

NEWS IN BRIEF

Ohio-based GE Aerospace has received a grant from JobsOhio to create new engineering jobs at its Peebles test facility. The grant will acquire new test equipment and create up to 200 new positions by the end of 2028.

The UK's Sustainable Aviation Fuel mandate has come into effect, meaning that aviation fuel from sustainable sources, such as used cooking oil and household waste, must make up at least 2% of all jet fuel in flights taking off from the UK. Effective from 2025, this must grow year-on-year to 10% by 2030 and 22% by 2040.

France's Direction Générale de l'Armement (DGA) has awarded its Mentor 2 contract for initial pilot training to Babcock International France Aviation. The contract includes 22 Pilatus PC-7 Mk.X aircraft and 12 simulators, which will be deployed at Salon-de-Provence to train crews for the Armée de l'Air et de l'Espace and Marine Nationale. The type will replace the Cirrus SR20/22 and Grob G120 in service.

China launched a Long March 5B rocket from the Wenchang Space Launch Centre on the island of Hainan on 16 December, carrying ten broadband satellites. They are the first of an estimated 13,000 satellites that will form the Guowang broadband megaconstellation in low Earth orbit (LEO).

The UAE's General Civil Aviation Authority has awarded design approval for the first commercial vertiport in the country. Developed by Skyports, the new structure is already under construction near Dubai International Airport, with plans to begin air taxi operations before the end of the year. Approved under the newly created UAE Vertiport Regulations, the site is the first of four that are being developed in association with Joby.

Cranfield University and University of Greenwich are set to conduct a series of live passenger evacuation trials this month using a blended wing body (BWB) cabin mock-up. The research will inform the design on next-

DEFENCE

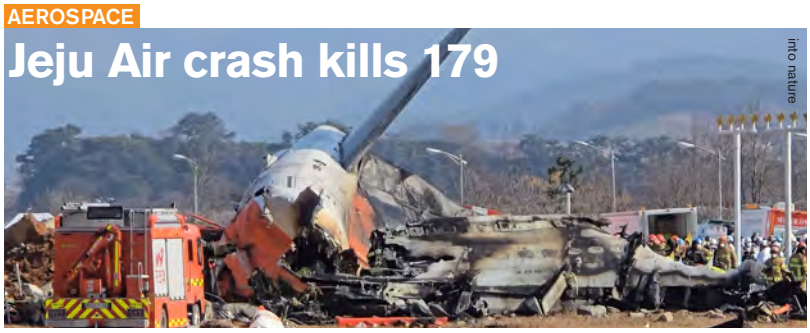
UK pledges mystery Gravehawk SAM system to Ukraine

During a visit to Kyiv by British PM, Sir Keir Starmer on 16 January, it was revealed that Britain would supply a hitherto unknown SAM system to Ukraine. The Gravehawk air defence system was developed as a rapid capability by UK and Denmark. Little is known about Gravehawk, except that it is able to use air-to-air missiles already in Ukraine's inventory albeit in a surface-to-air role. Two prototypes were already tested past September and a further 15 are set to be delivered this year.

- In mid-December, a Ukrainian F-16 pilot was credited with shooting down six Russian cruise missiles in a single mission – with two downed by AIM-120 and two with infrared AIM-9s before finishing the final pair off with cannon.

AEROSPACE

Jeju Air crash kills 179



A Boeing 737-800 operated by South Korean budget airline, Jeju Air crashed on landing at Muan International Airport on 29 December 2024, resulting in the deaths of 179 people, with only two cabin crew surviving. Flight 7C2216, departing from Bangkok in Thailand, was granted permission to land at 08:54 but, at 08:59, the pilot reported a bird strike, commenced a go-around and declared a Mayday, after which, permission was given for an alternative landing from the opposite direction, with the aircraft landing wheels-up halfway down the runway before hitting a concrete mound supporting an ILS localiser. According to news reports, while the CVR/FDR have been located, data from the last four minutes are missing.

GENERAL AVIATION

Aerial firefighters protect LA

More than 80 fixed-wing aircraft and helicopters, including Boeing 737s, DC-10s, BAe146s, C-130s, CL-415s, AW139s, S-70 Fire Hawks and Chinooks have been deployed to contain and halt the wildfires that started in Los Angeles in January and that covered more than 60 square miles. However, a collision between a Canadian CL-415 amphibian and a consumer quadcopter drone, which damaged its wing, led to a brief grounding of the fireflighting fleet. A Temporary Flight Restriction (TFR) was in place and authorities have pledged to prosecute rogue drone users.

AIR TRANSPORT

JetBlue hit with FAA's first fine for 'chronic delays'

US carrier, JetBlue has been hit with a $2m Department of Transportation (DOT) fine for "multiple chronically delayed flights." It is the first time the DOT has levied such a fine and it came as a result of what the department referred to as "prohibited, unrealistic scheduling practice which can harm both passengers and fair competition across the airline industry." Under DOT rules, a flight is chronically delayed if it is flown at least ten times a month and arrives more than 30 minutes late more than 50% of the time. JetBlue had four sectors classified as such on at least 145 times between June 2022 and November 2023. Meanwhile, on 15 January, the DOT also fined Frontier Airlines $650,000 for delayed flights and sued Southwest for allegedly operating flights that it knew would be significantly delayed.

generation novel airliner designs.

On 20 January, German low-cost carrier, Eurowings announced it was ordering 40 new Boeing 737-8 MAX airliners. Deliveries will commence in 2027.

On 27 December, Embraer announced it had signed a contract for two C-390 Millennium tactical airlifters with an 'undisclosed customer'. The latest order now brings the number of nations to have selected the C-390 up to ten, – after Brazil, Portugal, Hungary, South Korea, the Netherlands, Austria, the Czech Republic, Sweden and Slovakia.

Following a successful engine test in October, US-based rocket company, bluShift Aerospace is hopeful of making its first sub-orbital flight test towards the end of 2025. Using non-toxic biofuel containing an "agricultural by-product that can be obtained from farms around the world," the MAREVL (Modular Adaptable Rocket Engine for Vehicle Launch) engine will power the Starless Rogue rocket as it is launched from the firm's launch site in Maine.

The family of Leicester City FC owner, Khun Vichai Srivaddhanaprabha, who was killed along with four others when his AW169 crashed in the car park of the football stadium in October 2018, is suing Leonardo for £2.1bn alleging it failed to address design flaws in the helicopter. The UK AAIB report cited the seizure of a tail rotor component as the cause of the accident and Srivaddhanaprabha's family claims the manufacturer updated the design on several of its models, but not the variant involved.

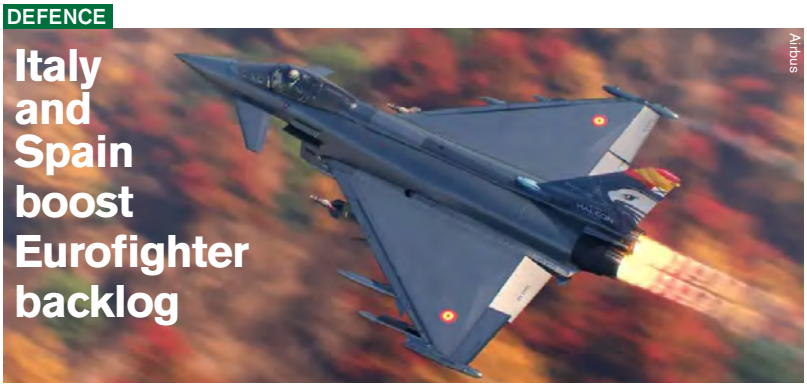
According to news reports, China's COMAC is aiming to increase its annual production capacity for its C919 single-aisle airliner to 50 this year. It also has the goal of delivering 30 aircraft this year.

Turboprop lessor, Abelo has converted an order for ten now cancelled ATR 42 STOL variants to five ATR 42-600s and five ATR 72-600s.

Radome

DEFENCE

Italy and Spain boost Eurofighter backlog



December saw Spain and Italy place significant follow-on orders for Eurofighters. On 20 December, Spain signed a formal contract with Eurofighter and the NATO Eurofighter and Tornado Management Agency (NETMA) for 25 airframes under its Halcon II programme and three days later Italy followed suit with an order for up to 24 aircraft. Spain's order consists of 21 single-seat aircraft and four two-seaters and includes 59 EJ200 engines. This is in addition to the Halcon I contract for 18 aircraft, signed in 2022, and will grow the Spanish Eurofighter fleet to 115 aircraft.

AIR TRANSPORT

Taiwanese airlines stock up on widebodies

Taiwanese flag carrier, China Airlines has split a $12bn widebody order equally between the two big manufacturers, signing agreements for ten Boeing 777-9 aircraft and ten Airbus A350-1000s on 19 December. It has also ordered four 777-8 freighters as it aims to capitalise on burgeoning e-commerce and pharmaceutical logistic flights in the region.

- Meanwhile on 9 January, Taiwanese airline STARLUX ordered five more examples of the Airbus A350F freighter variant by exercising options placed at the Singapore Airshow in February. This is in addition to the five that the airline originally ordered in 2024 for its STARLUX Cargo division. With this latest deal, the A350F has now won 63 orders from ten customers.

AEROSPACE

Boeing resumes 777X flight testing

Certification flight testing of Boeing's 777X has resumed after five months now the company has found a fix for a problem with the engine thrust links that had caused the test programme to be on hold since August 2024. The issue with the engine mounting structure came to light only five weeks into the certification flight test campaign.

Boeing is now targeting 2026 for certification and first delivery of the 777-9, some six years later than the original stated service entry date of 2020. The airframer has won more than 500 firm orders and 100+ options for the 777X, with customers including Emirates, Qatar Airways, Lufthansa and Singapore Airlines.

GENERAL AVIATION

First four-seat electric aircraft certificated

China's CAAC has become the first regulator to Type Certificate a four-seat electric aircraft under commercial Part 23 regulations. The RX4E, developed by Liaoning General Aviation Academy (LGAA) features a range of 300km, endurance of 1.5hr and batteries that can be swapped out between flights. Hong Kong's Volar Air Mobility will be the international sales partner for the aircraft with the goal of targeting Southeast Asia, the Middle East and Africa.

NEWS IN BRIEF

Lockheed Martin announced on 16 January that it had 'recently approved' the use of 50% synthetic aviation turbine fuels (SATF) for use with the F-35 and the following day the Royal Norwegian Air Force became the first air arm to do so.

NASA's investigation into the final flight of the Mars Ingenuity helicopter on 18 January 2024 has concluded that a failure by the vision navigation system caused a chain of events that ended the mission with a hard landing. Ingenuity's first pilot, Håvard Grip, said: "When running an accident investigation from 100 million miles away, you don't have any black boxes or eyewitnesses. While multiple scenarios are viable with the available data, we have one we believe is most likely: lack of surface texture gave the navigation system too little information to work with."

The UK's Vertical Aerospace says it has become "only the second company in the world to achieve piloted thrustborne flight manoeuvres with a full-scale vectored thrust eVTOL aircraft." The sortie, flown by Chief Test Pilot, Simon Davies at Vertical's base at Kemble, saw the VX4 prototype hover and successfully complete manoeuvres, including roll, yaw and spot turn elements. The company says it is now ready to begin piloted wing-borne testing with certification aimed at 2028.

Having tested its hypersonic rocket-powered autonomous Talon-A below its Roc carrier aircraft, Stratolaunch is now to expand the trials to its Boeing 747. The *Spirit of Mojave* previously served with Virgin Orbit but was acquired by Stratolaunch in 2023, following VO's collapse and the modified 747 will allow Talon testing to be undertaken from a much wider range of airports. Flights are planned to begin in Q4 of 2025.

German start-up, Evia Aero, which describes itself as "dedicated to transforming European travel through sustainable and carbon-neutral aviation," has signed a letter of intent with Britten-Norman to purchase 15 new Islander aircraft. The first aircraft

AEROSPACE

Boom counts down to Mach 1 flight

Boom Supersonic

As *AEROSPACE* goes to press in mid-January, US SST company, Boom Supersonic is set to attempt to break the sound barrier with its privately developed XB-1 technology demonstrator, with a window beginning on 27 January. On 10 January, a 44 minute test flight saw the aircraft reach Mach 0.95 and, on 17 January, Boom founder and CEO, Blake Scholl, said on X that two more flights were planned – with Flight 13 to be the last before the aircraft is retired. Two chase aircraft will be involved in the supersonic flights, with the Mach 1 test set to be live-streamed via Starlink. Scholl also says that the company plans to attempt to take a Schlieren photograph of the supersonic shock wave in flight.

DEFENCE

UK Parliament warns of ambitious GCAP timescale

In a report from the UK Parliament's Defence Committee on the (UK/Italy/Japan) Global Combat Air Programme (GCAP), MPs praised progress but drew attention to the ambitious in-service date of 2035 and the need to keep tight control of costs. In *The Global Combat Air Programme* report, published on 14 January, the Committee called on government to "consider a multi-year funding arrangement to put the programme on a secure footing and provide international partners with confidence in the UK's ongoing commitment." It also called for transparency on costs and budgets. Meanwhile, Reading, UK has been confirmed as the HQ of the trinational GCAP International Government Organisation (GIGO) which will act as the customer and procurement agency.

SPACEFLIGHT

NASA Parker Solar Probe skims the Sun

On 24 December, NASA's Parker Solar Probe made history by conducting the closest ever flyby of the Sun. Skimming only 6.1 million km from the surface and passing through the Sun's corona, the probe, which was launched in August 2018, also set a new speed record for a human-made object of 690,000km/h, thanks to previous gravitational slingshot manoeuvres between Venus and the Sun. The close approach to the Sun also saw the spacecraft endure temperatures of up to 980C. After its close approach on Christmas Eve, NASA regained contact with the probe on 26 December, with data being successfully sent back to mission control on 1 January.

AIR TRANSPORT

Qantas delays flights due to space debris

Qantas

Australian flag carrier, Qantas has revealed its schedules are now being impacted by the need to avoid airspace where rockets and space debris re-enter the Earth's atmosphere. Increasing launch cadence from SpaceX has meant that the airline has delayed flights on its Australia-South Africa routes by up to six hours to deconflict with the re-entry zone over the Indian Ocean – with South African Airways also reportedly delaying flights. On 16 January, SpaceX's seventh Starship/Super Heavy test flight saw the upper stage disintegrate, with the debris re-entering over the Turks and Caicos Islands.

will be delivered in 2027 with all subsequently to be converted to run on hydrogen fuel-cell propulsion systems. The deal also includes a collaboration agreement to redesign the Islander's interior to ensure compatibility with sustainable aviation technologies.

Engineers from BAE Systems Australia flew the new STRIX UAV for the first time in October. The eVTOL tiltbody aircraft has been designed to perform autonomous missions independent of a runway, including air-to-ground strike and ISTAR. During testing, the vehicle was flown entirely autonomously, albeit with a safety pilot standing by.

The University of Glasgow's James Watt School of Engineering has been awarded a patent for a new system which overcomes the challenges of 3D printing in zero gravity. Instead of the filaments used in Earthbound 3D printers, the system uses a granular material developed to flow from the feedstock tank in microgravity. The technology was tested aboard ESA's parabolic flight demonstrator, with three sorties providing 90 minutes of weightless experimentation.

Air India has ordered 31 single-engine Piper PA-28 Archer DXs and three twin-engine Diamond DA42s as it prepares to establish what it claims will be South Asia's largest flight training organisation (FTO) at Belora Airport in Amravati, Maharashtra. The first aircraft are expected to arrive in early 2025 with training to begin in the second half.

Germany's VÆRIDION has raised €14m in a Series A round of funding. The company hopes to bring its nine-seat VÆRIDION Microliner electric regional airliner concept to market by 2030. The new funding will augment the €1.4m of research funding secured from Bavarian and German authorities.

UK holiday operator, Jet2 has completed the phase-out of its Boeing 757 fleet – the last UK passenger 757s. The last aircraft carried out its final flight from Manchester to Geneva on 5 January. The final six aircraft in the fleet (from a peak of 13) started to be retired in November.

Radome

AIR TRANSPORT

Delta Air Lines to trial formation fuel-sipping flight

Delta Air Lines, which in 2025 celebrates its 100th anniversary, has announced it is to collaborate deeper with Airbus on testing and rolling out sustainable aviation technologies. The airline is partnering its own Sustainable Skies Lab with Airbus' UpNext innovation hub to explore wing performance, fuel efficiency, superconductivity and advanced aircraft assistance.

In addition, Delta will also conduct flight tests of Airbus' fello'fly formation concepts which aims to slash fuel burn by wake energy retrieval or 'surfing' the upwash of aircraft ahead. The next set of flight tests of this concept, drawn from migrating geese, is set for the second half of 2025. Finally, the airline will also work with Airbus to help scale up Sustainable Aviation Fuel.

DEFENCE

Augmented reality tested in Hawk T2

BAE Systems, the Royal Air Force and US start-up, Red 6 have conducted initial trial flights with an augmented reality (AR) display headset using Hawk T.2 trainers at RAF Valley. Projecting 3D objects, such as friendly and hostile aircraft, into the real world, Red 6's ATARS (Advanced Tactical Augmented Reality Systems) is being evaluated with a view to incorporating this next-gen technology into the syllabus to lower training costs and sharpen combat skills.

AEROSPACE

Türkiye's Baykar acquires Piaggio

After being in limbo for six years following entry into administration, Italy's Piaggio Aerospace has been acquired by Turkish company, Baykar. The buyout by the UAV manufacturer has now been approved by the Italian Ministry of Business, and Baykar CEO, Haluk Bayraktar said on social media: "We are proud to lead Piaggio Aerospace into the future, an icon of Italian aviation with 140 years of tradition." The manufacturer of the distinctive Avanti turboprop was forced to file for insolvency in 2018 when its major shareholder, Abu Dhabi sovereign wealth fund Mubadala, withdrew its support and last year the Italian government extended the deadline for the administration's conclusion until May 2025.

GENERAL AVIATION

Volocopter enters insolvency

On 26 December, German eVTOL developer, Volocopter filed for insolvency, citing a lack of ability to raise new funds to maintain regular operations. The company will continue to look for fresh funding while the insolvency proceedings continue. Outgoing CEO, Dirk Hoke, who steps down this month, said that the company still aims to certifcate and deliver its VoloCity this year, saying: "We are ahead of our industry peers in our technological, flight test and certification progress."

- Meanwhile, on 24 December, rival German AAM company, Lilium, which announced insolvency proceedings in late 2024, received a lifeline when investment consortium, Mobile Uplift Corporation agreed to provide "sufficient funding to restart business operations."

NEWS IN BRIEF

India's Hindustan Aeronautics Limited conducted the first engine ground run of its CATS Warrior drone at its Bengaluru facility on 11 January. The full-scale demonstrator of India's next-generation UCAV is designed to operate as a collaborative combat aircraft (CCA) and is quoted as having a 350km 'return range' and up to 800km for 'self-sacrifice' missions.

On 15 January a SpaceX Falcon 9 launched from Kennedy Space Center, Florida, with two lunar landers on board – one from US Firefly Aerospace, the other from Japan's ispace. Firefly's Blue Ghost lander is set to attempt a landing on the Moon in March, while ispace's Resilience lander, with a low-energy flight profile will arrive on the lunar surface some four and a half months later.

Gulfstream has delivered two further G700 business jets to the Qatar Executive fleet, growing the total to six with another four scheduled.

Research from the US FAA has found that eVTOLs downwash at landing pads could be equivalent to 'hurricane force' winds – due to higher disk loading and multiple propeller patterns interacting with each other.

ON THE MOVE

Japan's Oka Masami has been named the first CEO of the GCAP International Government Organisation (GIGO).

FAA Administrator, Mike Whitaker and Deputy Administrator, Katie Thomson have stepped down as the US transitions to a new administration.

Jorge Tamarit Degenhardt was appointed as CEO of Eurofighter on 7 January. He replaces Italy's Giancarlo Mezzanatto, who is returning to Leonardo.

President Donald Trump has picked Troy Meink, currently the principal deputy director for the National Reconnaissance Office, to serve as the next Secretary of the Air Force.

News Analysis

GENERAL AVIATION

Windracers unveil ULTRA MK2

Jack Richardson

Building on the success of its Uncrewed Low-Cost Transport Aircraft (ULTRA), UK drone manufacturer, Windracers has launched a MK2 version of its multirole utility UAV. *AEROSPACE* attended a launch event on London's Strand on 16 January 2024 where the new model was unveiled.

The company has upgraded the MK2 with enhancements in power, 50% more payload, ease of use and robustness. Speaking at the launch, Windracers Group CEO, Simon Thompson, said the MK2 was based on feedback from existing customers who said: "please don't change the fundamentals." The original 1,000km range ULTRA has been trialled by the Royal Mail, British Antarctic Survey, Lancashire Fire Service, Royal Navy and is in service in Ukraine. It is also partnered with US Purdue University as a research platform for its AI for Digital, Autonomous and Augmented Aviation (AIDA3) centre.

For the MK2 version the most eye-catching feature of this new model is the replacement of its flat twin boom tail with an inverted V-shaped one. This brings simplicity and enhanced cross-wind capability. The aircraft also features 50% increased payload to 150kg, new HIRTH F23 45hp engines, strengthened landing gear with drag-reducing fairings and a USB port for improved interaction with its avionics software. The removable wings also feature self-guiding attachments to allow two people to assemble it in the field.

New customers

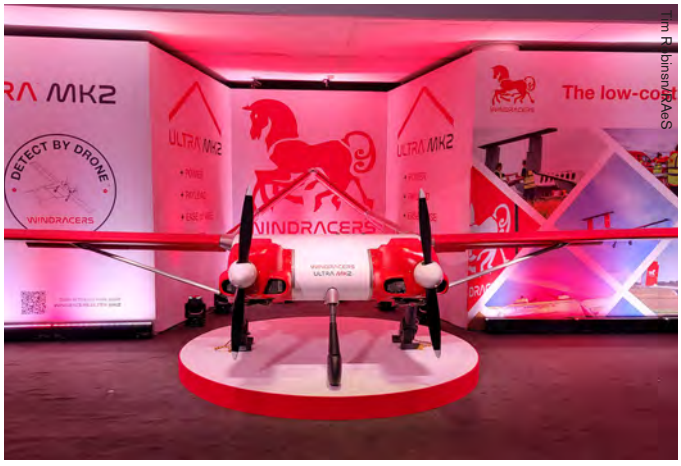
A panel discussion was held with two of Windracers' newest customers. Norwegian research institute, NORCE will deploy the ULTRA MK2 to Antarctica in order to monitor the movement of ice sheets and levels of snow being built up. Rune Storvold, Senior Vice President of NORCE, said the UAV will be equipped with ice-penetrating radars to monitor climate change. NORCE will receive its first example in March of this year. The second MK2 customer is Aviation Sans Frontières, which was described as 'an NGO at the service of NGOs.' This humanitarian organisation plans to use the ULTRA MK2 to deliver supplies, such as vaccines and aid, to remote areas in Africa – fulfilling the original vision of Windracers' founder and CEO, Stephen Wright.

On the front line

In addition to humanitarian missions, an undisclosed number of ULTRAs have been deployed to Ukraine for logistics resupply and reconnaissance missions via the UK MoD. Speaking to reporters, Wright noted how Ukraine is a test bed for UAV technology: "this is an awful thing to say, but there are ones in Ukraine and those [that are] not, it's where all the innovation is happening."

Thanking UK Research and Innovation in his speech for its support and backing, Wright gave reporters an idea of how close it was from making over the 'valley of death' between R&D and commercialisation: "whether we've got to the other side I don't know, but I just see it in touching distance, I don't think we're far from it."

He added that in the field of logistics, being able to perfect the ULTRA's delivery method of parachute drops (since 90% of cargo delivery is one way) in Ukraine has been key for product development,



Tim Robinson/RAeS

since such trials are restricted in the UK. Perhaps more interestingly, though, has been the ELINT operations carried out in Ukraine, monitoring Russian electronic emissions. From the start, Windracers has stressed the autonomous nature of the ULTRA, which has been designed in tandem with the company's own autopilot and mission control software. With this capability, the aircraft has been able to operate within areas that have GPS signals jammed.

Aerial firefighting potential

A matter of frustration to Wright has been seeing the wildfires that have engulfed California. The original ULTRA has been used in trials with Lancashire Fire and Rescue Service to monitor the spread of wildfires. Key to being able to assist in scenarios, such as this in the future, is having a large number of examples available. "You have to move to one operator operating 10, 20, 30," says Wright, an autonomous capability that will also slash costs. Further in the future, Wright also foresees the entire loading/unloading procedure could be made autonomous.

Although the company has managed to build dozens of ULTRAs over the last 18 months, there is a clear need to increase this in order to meet demand. To this end, Windracers is aiming to produce one airframe every day, moving away from the traditional bespoke aircraft production line for aircraft to one more akin to a car factory.

Windracers is offering its customers the options of 'ULTRA Direct', where the UAV (plus training and support) are sold to the operator and 'ULTRA as a service', where the company will be commissioned to plan and carry out the required mission.

A UK drone success story?

Indeed, after several false starts in the UK drone sector (Watchkeeper/Herti), Britain's Windracers is now on the cusp of global sales success with its Ultra MK2 drone product. Its simple, rugged and cheap UAV could well be set to become the Land Rover of the skies – and an example of how governments, through bodies like UKRI can stimulate disruptive technology and help innovators cross the 'valley of death' that transforms R&D into a commercial product.

By the Numbers

Understanding the world of Aerospace through data

Airbus-Boeing Orders 2017 – 2024

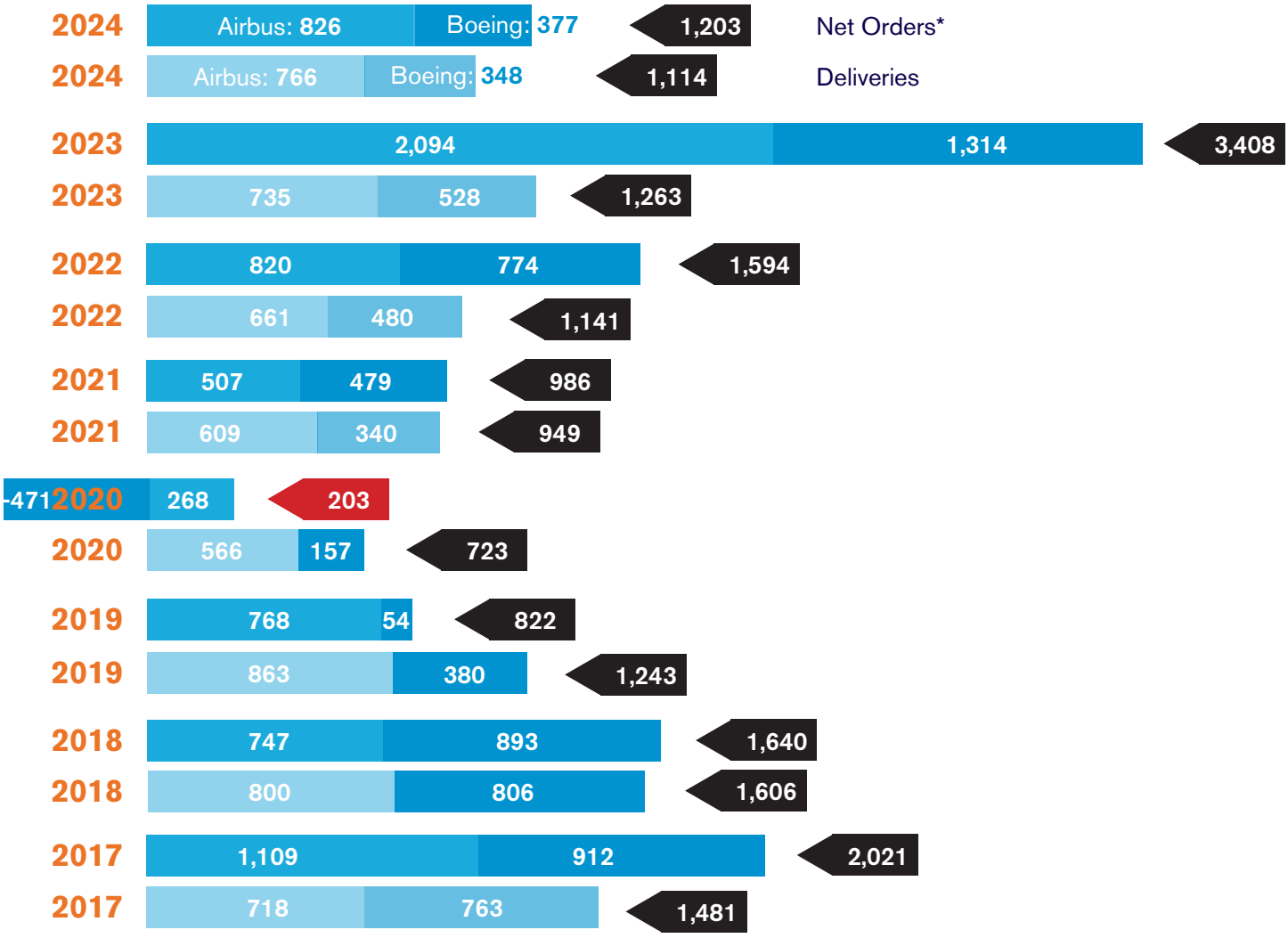
Airbus

Aer Lingus, Ireland's national carrier, has just taken delivery of its first of six A321XLR aircraft. The airline is the second in the world to operate the A321XLR and the second in the International Airlines Group.

Boeing

Wayne J Davis/RAeS

Turkish low-cost airline, Pegasus is overhauling its fleet with an order for 100 Boeing 737 MAX 10 aircraft. The contract also allows the carrier to buy up to 100 more at a later date.



*Net orders include orders minus cancellations.
Sources: Airbus and Boeing

Pushing the Envelope

Exploring advances on the leading edge of aerospace

Robert Coppinger

Using optical fibres for in-flight health checks

For more than a century, aircraft maintenance has involved checking engines and airframes at fixed intervals – but what if an aircraft could tell its maintainers what was wrong with it when it went wrong? In such cases, those fixed inspection intervals could be reduced to occasional downtime.

The needs and safety of human pilots have ensured there are limits on how many flight hours an aircraft can be operated for – and this has had a direct bearing on an aircraft's maintenance needs. However, the development of drones that can operate non-stop, with little remote pilot input, means aviation's potential level of operations and applications have increased.

Optical fibre snaking through a fuselage is one solution to monitor the health of an airframe and enable this intelligent maintenance-aware aircraft. As part of a UK government-funded 12-month technology maturation project at the University of Southampton, which finishes this February, a drone has been flying with optical fibre that beams information to the ground from an on-board computer. The project's lead researchers are Dr Christopher Holmes from the School of Engineering and Dr Martynas Beresna from the Optoelectronics Research Centre. Holmes explained that finite element analysis simulations of the drone helped identify the wing strain hotspots and that is where the optical fibres were placed. While research has been conducted by the likes of NASA over many years to embed optical fibre inside a composite fibre fuselage section, the Southampton researchers attached theirs to the outside of the 2m wingspan glassfibre drone – which had been developed by undergraduates for a different degree project and can fly at 120mph.

Beaming data

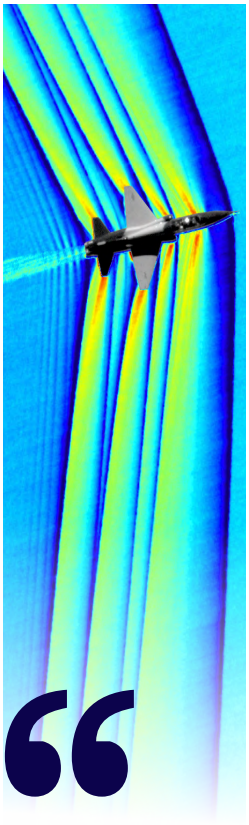
The optical fibre and its computer were retrofitted to the drone for four test flights over three days that occurred last October. The use of optical fibres and their medium of light avoids problems with possible electromagnetic interference from alternative technologies and the researchers' primary interest was measuring stress on the wing. This optical fibre sensor system's computer transmitted its strain data to the ground control during the flight. The optical fibre output data from the four test flights was also compared with accelerometer data and other electronic data that was gathered on board the aircraft. For Holmes and Beresna, demonstrating that the small low-power on-board computer could work was a key objective.

The way the fibre provides data is that the strain on the wing is also experienced by the fibre and this changes the light reflectivity within the fibre. It then reflects different wavelengths differently as the strain changes and the wavelength shift can be correlated to a wing strain change.

Beresna said that it is normally relatively expensive to monitor wavelength shifts but he and his fellow researchers have created a new approach that reduces that cost. Holmes explained that this lower cost comes from the use of machine learning (ML) software with advanced algorithms providing more of the solution than the hardware.

Holmes said the signal processing of the light – getting the information out – was where the novelty in their technology sits. The sensor system's computer receives the data via a camera which detects the returned light. In combination with the optical fibre and the camera, small (1mm x 1mm) slivers of what is called 'flat fibre' are also used as scattering structures to create what is called a 'speckle' from the fibre's returned light. ML software then allows the computer to interpret that speckle shape as a strain reading.

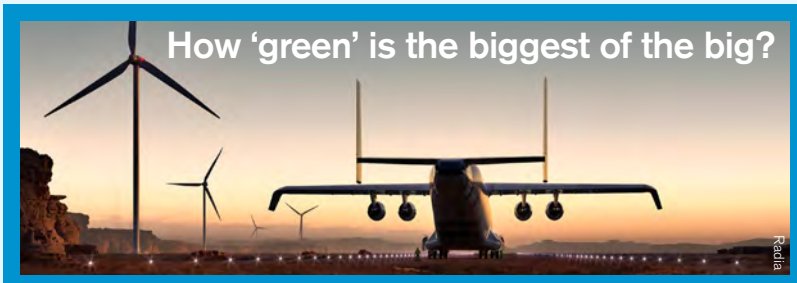
The inventors of this optical fibre health monitoring technology are hoping to commercialise it in 2025 through their company, Asterium.



> THE USE OF OPTICAL FIBRES AND THEIR MEDIUM OF LIGHT AVOIDS PROBLEMS WITH POSSIBLE ELECTRO-MAGNETIC INTERFERENCE FROM ALTERNATIVE TECHNOLOGIES

LETTERS

How 'green' is the biggest of the big?



While I'm normally in favour of any advancement in aerospace that involves higher, faster, farther, bigger or better, I am having a hard time with this one ('The Biggest of the Big,' *AEROSPACE*, December 2024).

Clearly, not all advocates of 'green energy' care about birds, whales, noise and hazards to navigation or the ruination of a panoramic natural view – but they should care about efficiency. Radia wants to "build the world's largest aircraft by volume" to carry some of the world's largest structures made of carbon fibre – a material that is energy-intensive to produce life-limited, non-biodegradable, and not economically recyclable – to facilitate what is likely the world's most dilute and unreliable form of power generation: wind turbines. What is 'green' about that?

William Mnich FRAeS

A musical memory of Amelia Earhart

Thank you so much for featuring our album, *The Last Flight,* as an addendum to your annual *AEROSPACE* book choices of 2024 blog[1]. The band has been sent the link by a number of people so it is obviously very well respected in the aeronautical world!

We are glad that you enjoyed our homage to Amelia Earhart and thank you for your ongoing support of Public Service Broadcasting.

J Willgoose Esq
Public Service Broadcasting

ONLINE

Engineering shortage

Response 'Is civil aviation in danger of being grounded due to a lack of maintenance personnel?'

@sheepie.bsky.social They need to make it financially attractive. Apprenticeships are paying minimum wage, which might be OK for school leavers, but for those wanting to retrain into the industry, it is just not affordable.

@npostorino.bsky.social I have no idea how any of these young aircraft engineers make ends meet in the UK. Even for experienced engineers most of the jobs are around London and airline pay isn't enough to afford half of their rent.

The value of UPRT

Response to 'Five years on from the EASA-mandated Upset Recovery and Prevention Training, is it delivering results?'[2]

@bobmm.bsky.social A good article. Unfortunately, integrated training packages are producing airliner operators rather than aviators and, as 'Greeners' says, unless basic skills are taught early and kept reviewed they will not be there when needed.

Blade Runner

Response to 'Radia has designed its enormous WindRunner to transport turbine blades to remote sites by air.'

Richard Mallory Allnutt It seems utterly bonkers but the team assembled to design it seems to be populated by serious people. I hope they succeed!

Steve Panter That's a lot of big names on the board but I feel the timeline of flying and delivering by the end of the decade is very sporty, as is the plan to operate off dirt strips.

It will be interesting to see where they would assemble the aircraft as that facility alone will be enormous?

I wonder if this is something that Hybrid Air Vehicles could try to add to Airlander's capability?

Tim Kern They'll still have to load them onto multiple trucks to get them to and then from the airport. Maybe they'll have a future as flying archery or pistol ranges?

Damien Burke Is it practical to road in everything you need to construct a massive runway?

Bryn Forbes Maybe they just have to get close enough that there are no overpasses or tight turns for trucks to get through. Or close enough for helicopters to do the proverbial last mile?

Plug and play?

Response to 'Chinese electric aircraft that received CS-23 certification features swappable batteries, thus negating the need to wait between recharges.'

Tom Carlill Swappable batteries are becoming common in China with various automated methods to swap them in automobiles. It will be interesting to see how aviation safety standards adapt.

Neil Gascoigne Swapping batteries adds cost, both to purchase and to certify that the unit is serviceable. Range will also diminish with service life and this will no doubt need to be included in the performance calculations.

Dave Hadfield I have always thought this was the best way to do electric small aircraft – exactly like the DeWalt batteries on charge in my shop! A battery change should be made simple enough that it qualifies as 'elementary work', like changing spark plugs, or inflating a tyre, only easier.

Nick West This seems highly logical to me.

Obin Robinson I am all for it if it makes aviation more affordable, accessible and safe.

Tim Jinks 'Affordable' is far from achievable with existing electrical energy density. There is no getting away from the unbelievable amount of energy stored in liquid fuel per kg compared to batteries – 13,000 watt-hours per kg petrol versus 200 watt-hours per kg battery. A full tank of liquid fuel in a typical car (petrol or diesel) contains as much energy as approximately 1,000 sticks of dynamite. The research effort and expenditure would be vastly more worthwhile directed to producing a more renewable and cleaner liquid fuel to use in proven technology engines.

Steve Zimmermann I see no use case for a four-seat electric aeroplane. Circuit training is the only rational use case for the two-seat version.

The next problem?

Response to 'Could the next big environmental problem come from space?'[3]

Adam Setchfield Kessler syndrome is a bigger threat than pollution from satellite dust. I wonder if studies have been undertaken on launch vehicles, such as Starship New Glenn and Neutron which use LOX/CH4 as fuel?

Zane Adams The Earth will survive anything humanity throws at it. The climate is a short-term human problem. The vanity of humans thinking they can control the planet is just that, vanity. Earth will do what it is going to do, whether we are here or not.

Contrail management

Response to 'Aviation can rapidly reduce its climate change effects now – so what are we waiting for?'[4]

Nigel Hitchman Would the assumptions about contrails trapping in heat have the same effect over the ocean, which warms up much less during the day than ground temperatures change? The assumptions on increased fuel consumption seem to be as a percentage of the whole flight rather than assuming the aircraft is held low for only a short proportion of the flight. From my time on the 777, I remember it being more like 2% per hour for flying 2,000ft low. However what the author does not take into account is that for one aircraft not flying at its optimum altitude it also means that every aircraft below it has to fly 1,000ft or more lower. So, assuming his facts of the height of the icing region some being 1km thick are correct, that means three or more 1,000ft levels not being used. So every aircraft will end up 3,000ft lower than optimum. The excess fuel consumption is not linear, so the ones at the lower levels (already where they did not want to be) will see an even bigger increase. A better contribution would be removing the ban on aircraft landing at Heathrow before 06:00 so, on days where there is a good tailwind across the Atlantic, they will not be holding for 20 minutes!

Lost in translation

Response to 'Research into how a multilingual context might affect high-risk environments.'[5]

Thiago Silva Discussions about these topics usually occur in isolation, but this article brings to light how intrinsically linked CRM and languages are. In my experience teaching English for aviation in Brazil, the language factor has often been neglected in accident and incident investigations. Many colleagues in this field have observed this glaring gap and, sadly, it seems to be a global issue. Even the forms investigators use rarely consider language as a contributing factor, which is concerning given its critical role in communication. The final report of a major air crash in Brazil referenced language 28 times, with over 60 safety recommendations tied to language proficiency. This reinforces the undeniable importance of language in safety.

GCAP Joint Venture

Response to 'GCAP industry partners from UK, Italy and Japan announce milestone Joint Venture at RAeS HQ.'

@tred247 A great day for British defence and industrial diplomacy.

@inklinkerman It has definitely got the looks – obviously the Italian cosmetics! Hopefully it will have Japanese production and engineering and the UK gets managerial oversight!

Airbus CEO at RAeS HQ

Response to 'Speaking at RAeS HQ, Airbus CEO, Guillaume Faury, notes success of A320 family, saying initial sales prediction when launched was 600. Airbus is now delivering 600(!) a year and is preparing a "volume production system."

@FacelessManTwit I am pretty sure Boeing wishes it had Airbus' problems, not Boeing's problems.

China is boxing clever

Response to 'Bill Sweetman analyses the Chinese military aircraft revealed on Boxing Day. Is it the clearest evidence yet that the UK is on the right track with GCAP?'[6]

@Dr_M_Davis Agree, it is time to move on from short-range fighters. The Indo-Pacific operational environment demands longer, hemispheric range and high payload and performance. – plus connectivity with autonomous wingmen. GCAP is heading in that direction, and it looks like China is too.

@epelgrino I didn't know the UK was an Indo-Pacific nation, why should its requirements be aligned with Chinese ones? Why would the UK be more focused on Pacific threats when Russia is nearby and US is a Pacific country? Why would the UK need a long-range and huge internal payload?

@Guy_Ramsden The UK is an island, so any war is going to be expeditionary and that will require long range.

@crisc3000 Japan is also in the GCAP consortium, and it needs a long-range fighter with a large weapons bay. Russia is also thinking of something similar with the MiG-41(PAK-DP programme) which will replace the MiG-31, so we also need a 'stealth missile bus'.

@PeterReoch It looks like they got their design inspiration from Gerry Anderson, it is an incredible looking machine!

@TercioNorte1 This type of fighter is for a very specific Asia-Pacific environment. I do not think it is suitable for Europe-Russia.

@StephanVelines Western European nations don't want to rely on front-line airbases for deployment. A large payload and range means they can return to home base to refuel and rearm.

@Tim_Reid79 Those control surfaces; are they hingeless with flexible skin?

@JoseM_SGP It is enormous! It looks more like a 5th Gen attack/bomber aircraft than like a sixth-gen fighter to me.

@MichaelJPryce Maybe the Chinese want to cruise/loiter on one or two engines then go madly fast in bursts (or all the time)? It is hard to know at this point, but it looks complex and costly. I wonder how it will play in the 'drones are all you need' debate.

Too late to the party?

Response to 'In conversation with the UK Space Agency's Director of Launch.'[7]

@AO156 Sadly I think UK has missed its opportunity. Launch companies (especially new ones) cannot sit around waiting and burning money. With Norway seemingly doing everything it can to win business, the UK will have to show itself to be very supportive to win business.

1. aerosociety.com/news/aerospace-book-choices-for-christmas-2024/
2. aerosociety.com/news/regaining-control/
3. aerosociety.com/news/could-the-next-big-environmental-problem-come-from-space/
4. aerosociety.com/news/contrail-control-what-are-we-waiting-for/
5. aerosociety.com/news/lost-in-translation/
6. aerosociety.com/news/boxing-clever-chinas-next-gen-tailless-combat-aircraft-analysed/
7. aerosociety.com/news/plane-speaking-uk-space-agency-director-of-launch-matt-archer/

And then there was one...

Ahead of the RAeS Flight Operations Conference on Single Pilot Operations in March, Capt **SEBASTIAN HALL** from Emirates Aviation University analyses the public perception of the idea of 'going solo'.

Technological advances in automation have lead some within the aviation industry to question whether it is still absolutely necessary to have two pilots always at the controls of modern passenger aircraft. However, the concept of Single Pilot Operations (SPO) has become a highly controversial idea, with pilot trade unions claiming that it is a classic case of large firms prioritising profits over safety.

While the disagreement may seem as traditional as the Luddite movement of 18th Century England and the very origins of the trade union movement, this dispute has taken on a characteristic previously unseen within the aviation industry. Whereas the final arbiters of whether a new technology is safe have traditionally been the regulators, with airlines, trade unions and manufacturers all trying to influence the regulator's opinion, the stakeholders have calculated that it is the general public's opinion that will be most impactful on the future of SPO.

Thus, those stakeholders have all embarked on deliberate and distinct public messaging campaigns. The world's pilot trade unions have been by far the most active in this regard, engaging in co-ordinated and aggressive campaigns that have even gone so far as to question the integrity of the regulators.

Meanwhile, the manufacturers, in particular Airbus, who have become the *de facto* SPO cheerleaders, have adopted a public messaging campaign that is much more deliberate and considered. The airlines seem to have embarked on a campaign strategy that involves saying as little as possible on the subject of SPO. Analysis and comparison of these public messaging strategies through the use of secondary research, reveals interesting insights into the possible future of SPO.

Digging into the data

Advances in technology have always been the foundation upon which aviation has progressed. The jet engine, computers and modern composite

materials are just a few examples of technological breakthroughs that have spawned paradigm shifts for the industry. We are now, potentially, on the brink of another fundamental change to commercial aviation: the introduction of SPO.

While there have been numerous studies into the public's attitude towards SPO, to date there has been no analysis of how the industry stakeholders are trying to affect it. This article will examine the various attempts to influence the public's perception of SPO and assess how their approaches might shape the future of SPO.

The study used secondary research to identify trends within existing literature, drawing conclusions on the key stakeholders' strategies for influencing the debate surrounding this controversial issue. The literature examined was varied and wide-ranging, from classical economic theory to recent social media posts, and Google and Google Scholar were employed as the primary academic search engines.

Existing literature

A NASA Technical Interchange conference in 2012 highlighted the differing opinions on how the public would react to SPO. Some participants suggested that the general public might gladly accept SPO if the regulator certified it and it resulted in noticeably lower ticket prices. Others believed that the public might see it as a significant reduction in safety.

Despite the lack of consensus about the public's attitude to SPO, there is general agreement about its critical importance for any future implementation. Myers *et al*[1] stated that the greatest obstacle to SPO is the overall public perception of the impact on aviation safety while Bennett *et al*[2] described public acceptance as a prerequisite of SPO.

Some researchers have claimed that there is a shift towards increased acceptance of such technologies, given the increasing prominence of automatous technologies in recent years, in particular within the automotive industry.

Al Thani makes a similar claim in his comprehensive, but not yet peer-reviewed, paper on public attitudes to SPO. He asserts that, in general, people's perception of SPO has shifted in a favourable direction. However, the absence of comparable data from the past, or any form of longitudinal study, makes this claim somewhat dubious. That said, his large sample size and application of a linear regression model means his paper offers useful quantitative data on the current relationship between respondents' demographics and attitudes to SPO. Al Thani shows that none of the age or sex categories reach the standard threshold of $p<0.05$, implying that the coefficients were not statistically significant. That is to say, the public's opinion on SPO is equally diverse across the age and sex demographics. This type of insight may seem somewhat inconsequential, but for those attempting to strategically influence the public's opinion, such an understanding is valuable.

The 'cost' of a pilot

Depending on factors like flight time and number of passengers on board, it has been estimated that pilot salaries constitute somewhere between 11-25% of the operating costs for each flight leading some to declare that the airlines' sole objective for SPO is to reduce costs and increase profits.

Others have speculated that passengers would benefit from a drop in ticket prices after the introduction of SPO while the pilot trade unions claim that the airlines' desire for reducing their operating costs equates to a desire to increase their profit margin, not to reduce their customers' ticket prices.

As a possible argument against this, Myers *et al* showed that over a 12-year period, starting from 2000, 30% of all US-based airlines had filed for Chapter 11 bankruptcies, with the major culprit being rapidly increasing operating expenses and, of that, pilot labour costs accounting for more than $9bn. Thus, it could be argued from a traditional economic standpoint, that by simply having fewer airlines fail, the increased competition will keep ticket costs lower for the consumer without the need for any benevolence from the firms.

Furthermore, the recent rapidly-increasing airfares and the potential for an initiative that could theoretically reduce ticket prices, would also make customers more accepting to something which might have previously seemed risky. However, there are obvious weaknesses inherent in studies which claim to measure public opinion, especially on a subject which is complex and difficult to fully understand for the average person, such as the safety ramifications of SPO.

Public attitude is fickle and especially hard to measure with surveys. The responses given are generally emotive and highly dependent on the precise wording of the question. Moreover, passengers' perception of what is safe or unsafe may even be contrary to the facts and data. A good example of this can be seen in the seating layout of every modern large passenger aircraft. It has long been known that passenger seats facing backwards are demonstrably much safer than seats facing forwards in the event of an accident.

Early studies showed that, in the event of a crash, survival rates were ten times higher if passengers sat in a rearward-facing seat. However, passengers feel safer facing forwards, so, when given the option on older aircraft, some of which had seats facing in both directions, the forward-facing seats would always sell out first. Thus, manufacturers responded to the airlines' wishes and switched to producing aircraft with only forward-facing seats.

> THE USE OF THE TERM 'EXTENDED MINIMUM CREW OPERATIONS' [IS] A DELIBERATE ATTEMPT TO OBFUSCATE THE TRUTH BY NOT INCLUDING THE WORDS 'SINGLE PILOT
>
> **Captain Jason Ambrosi**
> ALPA President

▼ The days of cluttered, unergonomic cockpits have long gone – does that mean the days of co-pilots and first officers can go too?

(1) Myers, PL and Starr, AW (2021) Single Pilot Operations in Commercial Cockpits: Background, Challenges, and Options. Journal of Intelligent and Robotic Systems: Theory and Applications, 102(1). DOI:10.1007/s10846-021-01371-9.

(2) Bennett, R and Vijaygopal, R (2021) Air passenger attitudes towards pilotless aircraft. Research in Transportation Business & Management, 41 100656. https://oro.open.ac.uk/75913/

Another cognitive bias relevant to consumer preferences, which is also applicable to the introduction of something as contentious and novel as SPO, is the Diffusion of Innovations theory which says that only around 2.5% of consumers are willing to try a product or innovation at the time of release. Furthermore, Resistance Theory dictates that customers usually treat an innovation negatively, especially at the first stages of its diffusion. One should expect both these theories to be on the conservative side when applied to SPO, given that it has possible implications for the customers' personal safety rather than simply being a matter of consumer preference.

Interestingly, a 2023 study by Zinn *et al*[3] assessed pilots' attitudes to SPO before and after a detailed explanation of possible risk mitigations. Although the pilots' perception of the risks involved remained high, it decreased significantly after the detailed explanation of how risks can be mitigated.

Cummings *et al*[4] also conducted a survey of pilots' attitudes to SPO. Even though the respondents, as pilots, had the advantage of being somewhat informed about the subject matter, the data was weakened by a small sample size and the presence of another cognitive bias known as Motivated Reasoning. The qualitative study was based on open-ended interviews with eleven experienced pilots, ten of whom were captains.

It can be argued that, having already been promoted to the rank of captain and, therefore, being unlikely to have their own professional advancement affected by the introduction of SPO, their attitude towards SPO would be significantly different from that of a pilot at the beginning of their career who could have their progression delayed if the airlines suddenly required fewer pilots to cover the same amount of flying. It should, therefore, be unsurprising that some of the captains interviewed felt that "the loss of the other pilot was not such a negative."

TWO PILOTS ARE JUST AS NECESSARY.
TWO IS ALWAYS SAFER.
WHEN HUNDREDS OF LIVES ARE AT STAKE, ONE IS NEVER ENOUGH.
KEEP TWO PILOTS ON THE FLIGHT DECK.
SAFETY²
Safe flights depend on the power of two pilots.
SAFETY²
Two pilots on every flight increase safety exponentially.

All via ALPA

▲ The Air Line Pilots Association's social media campaign has been thought provoking and pointed.

The view of the airlines

The airlines are conspicuously quiet on the matter of SPO, publishing little in favour of it despite being the greatest beneficiaries. According to an analysis performed by the Air Line Pilots Association (ALPA) and Bryce Space and Technology Group, SPO could save US airlines and air transport companies some $8.3bn per year in salaries, personnel expenses and benefits. When asked directly by the popular aviation press, airlines often refuse to comment on the subject of SPO. Such coyness has inevitably led to plenty of speculation that the airlines have been active behind the scenes, lobbying the OEMs to begin the necessary R&D and seek regulatory approval.

Furthermore, airlines have seemed to distance themselves from the manufacturers' efforts towards SPO. Cathy Pacific was the first (and last) airline to announce any formal efforts towards SPO in conjunction with Airbus when, in 2021, they jointly announced the existence of Project Connect. However, precise details were scant and it was reported that

[3] Zinn, F, della Guardia, J, and Albers, F. (2023). Pilot's Perspective on Single Pilot Operation: Challenges or Showstoppers. Engineering Psychology and Cognitive Ergonomics. Lecture Notes in Computer Science, vol 14018. https://link.springer.com/

[4] Cummings, ML, Stimpson, A and Clamann, M (2017) Commercial Pilot Views on Futuristic Single Pilot Operations. Duke University. https://doi.org/10.2514/6.2016-1652

the industry briefings were held behind 'closed doors'. Airbus has now rebranded the project as 'extended Minimum Crew Operations' (eMCO), and any link to Cathay Pacific, or any other airline, has been removed.

Despite airlines' obvious ambitions to fly aircraft with as few pilots as soon as possible, a passenger airline's premature adoption of SPO could be extremely costly if the public were unwilling to accept it. After all, there would be many alternative airlines, still operating with the traditional two pilots, for the customers to choose instead. This could explain why no US airline CEOs have publicly embraced the reduced-crew concept, despite the European regulator pushing hard for a comprehensive safety analysis.

The view of the OEMs

Just one month after becoming the new Chief Executive of Commercial Aircraft at Airbus, Christian Scherer told *The Times* newspaper that airliners could already be flown by a single pilot, defending the manufacturer's eMCO project.

On its website, Airbus describes eMCO as "an innovation that enables the flight crew to better organise their presence in the cockpit during the cruise phase, thanks to additional automated functions". However, ALPA President, Captain Jason Ambrosi, has called the use of the term 'extended minimum crew operations' a "deliberate attempt to obfuscate the truth by not including the words 'single pilot'". It is true that Airbus' autonomous projects webpage makes no mention of the term 'single pilot operations' and every use of the word 'pilot' is in its plural form.

While appearing less enthusiastic about SPO than its European counterparts, it is notable that Boeing executives (like the US airline CEOs) have generally remained quiet about their position regarding SPO.

That said, away from the US, the Boeing Southeast Asia President, Alexander Feldman told a *Bloomberg* business summit in Bangkok in 2022 that "the technology is there for single pilots. It is really about where the regulators and the general public feel comfortable. The psychological barriers are probably harder than the technological barriers". Such a statement could imply that Boeing believes any fear of SPO is more emotional than intellectual. In the absence of any comprehensive safety analysis of SPO, this statement could easily give the impression that Boeing has scant regard for the safety implications, and it is notable that no other Boeing executives have made any similar remarks in the two years since.

The view of the regulators

The regulators appear to appreciate the importance of the general public's opinions on the subject of SPO, and have been predictably agnostic on the subject. However, the fervour with which EASA is pursuing the comprehensive analysis is seen by many as being indicative of its appetite for future SPO. Evidence of EASA's commitment to investigating SPO is the awarding of a €1m contract to the Dutch firm, NLR to lead the initial research.

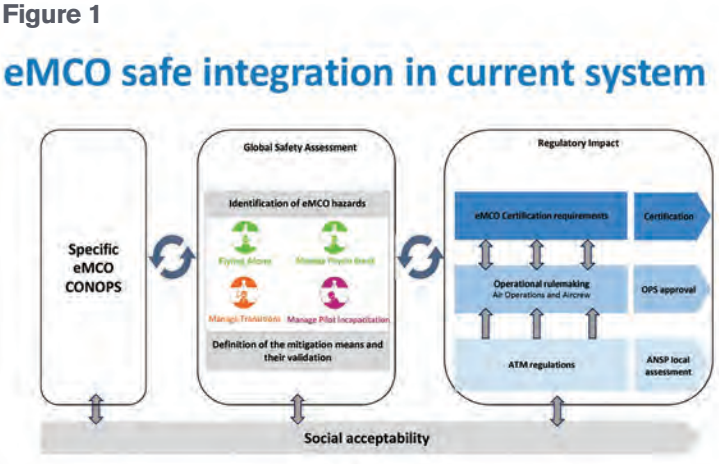
Aside from EASA's push to fully explore the feasibility and safety implications of SPO, it recently presented a diagram which outlined the likely future steps towards SPO (see Figure 1 below). It is notable that the entire process is underpinned by 'Social Acceptability,' demonstrating the regulator's appreciation of the importance of the public's attitude towards SPO.

The regulators release papers and hold regular workshops on the feasibility of SPO. The global regulator, ICAO, has issued clear direction to all national regulators that the implementation of SPO will only be acceptable if it is proven that safety levels are at least maintained or even enhanced. In the ICAO working paper, the introductory paragraph

OneMeansNone
Can you handle two emergencies at the same time?
Planemakers want only one pilot at the controls of an airplane!
But what if the pilot needs a bathroom break or gets unwell right when the plane hits turbulence or has an emergency?
one means none
onemeansnone.eu

▲ One of the adverts that the OneMeansNone organisation has been placing in airport terminal lavatories as part of its anti-SPO campaign.

Figure 1



◀ Left to right: Boeing Clipper (five cockpit crew), Tupolev Tu-154 (four crew, plus an observer in this case), Boeing 707 (three crew), Airbus A310 (two crew) and Airbus' proposed single pilot operation.

compares SPO with the previous introduction of Reduced Vertical Separation Minimums (RVSM), Extended Twin Engine Operations (ETOPS) and Required Navigational Performance (RNP); all these concepts used technological advances as justification to reduce safety margins between aircraft, terrain and alternate airfields.

These operations are now commonplace and their implementation attracted no resistance from the public or pilot trade unions.

The view of the pilot trade unions

In contrast to the airlines, the trade unions have been highly vocal on the subject of SPO. Since the release of the ICAO working paper, inviting regulators to assess the various ways in which the risks generated by SPO could be mitigated, the world's pilot trade unions have joined forces and embarked on a co-ordinated campaign to discredit the concept. The degree of collaboration has resulted in a clear and co-ordinated strategy; convince the general public that SPO is inherently dangerous, and that any airline contemplating the idea is an airline that prioritises profits over safety.

Their hope is that the issue becomes so controversial that no airline is prepared to align themselves with an OEM by becoming the lead customer. If manufacturers cannot secure a lead customer, then the entire SPO project comes to a standstill. The ALPA paper is explicit about this tactic where it states "unless single-pilot operations are universal, an early adopter would lose business from safety-conscious customers".

Furthermore, the trade unions have also publicly stated that they do not trust the regulators to appropriately regulate the behaviours of the manufacturers. They have warned of 'regulatory capture,' where a regulatory agency is *de facto* co-opted to serve the commercial interest of a commercial entity whom they are supposed to regulate.

As a result of this lack of trust, the European Cockpit Association has called for experts not associated with the regulators to be involved in compiling the safety case.

Trade unions have adopted techniques and strategies akin to a political party's election campaigning. The 'Safety Starts with 2' website offers its readers a 'Social Media Toolkit' complete with campaign material ready for its website visitors to add directly to their own social media feeds.

Furthermore, they have recruited well-known aviation celebrities to amplify their message, like Capt 'Sully' Sullenberger who famously captained the Miracle on the Hudson River in New York City.

Given the unity and co-ordination between the world's pilot trade unions on the subject of SPO, it should be no surprise that they all list the same risks and downsides of SPOs. Aside from the numerous scenarios in which SPO would reduce safety margins,

> INVESTMENT IN SPO RESEARCH AND DEVELOPMENT MEANS FEWER RESOURCES ARE AVAILABLE FOR PURSUING OTHER, MORE WORTHWHILE INITIATIVES, NAMELY ENVIRONMENTAL ONES

the unions have also claimed that any continued or further investment in SPO research and development means that fewer resources are available for pursuing other, more worthwhile initiatives, namely environmental ones.

This, combined with the conspicuous and considerable attempts to shame any airlines that are involved in analysing the safety case for SPO, could imply that the trade unions are not confident that a traditional and rational safety assessment (inevitably conducted by the regulators) will reach the conclusions they would support. They would presumably prefer to stop the idea early in its tracks and before the safety analysis is conducted.

Conclusion

The fact that the airlines have seemingly distanced themselves from the subject, releasing no official statements nor openly collaborating with the OEMs or regulators, should still be viewed as a deliberate public-opinion-management strategy. The OEMs, somewhat immune from the downsides of any public backlash since the public are not their direct customers, are also treading carefully around the issue but releasing occasional soundbites about the technical feasibility of SPO. The regulators (in particular EASA) are the public-facing organisations intent on fully exploring the feasibility of SPO, but are frequently reiterating the ICAO requirement for levels of safety to be at least the same as with two pilots. If a clandestine effort by the airlines to push through SPO genuinely exists (as the trade unions frequently claim), it would make sense that the airlines take cover behind the OEMs and regulators, saying little publicly themselves.

The world's pilot trade unions have united like never before around the issue of SPO. Additionally, they have embarked on a well-co-ordinated and significant public messaging campaign with the obvious objective of convincing the public that SPO would be highly dangerous and that any airline offering the idea any credence is an airline that puts profits ahead of safety. ALPA have even stressed the importance of 'the will of the people' in their paper about the dangers of SPO, a term with strong connotations of freedom and democracy. Furthermore, the use of campaign material and calling for supporters to 'spread the word' shows that the trade unions are approaching the issue like a well-organised political party ahead of an upcoming election.

The Zinn study, which measured how pilots changed their attitude to SPOs once they had been fully educated on the various risk mitigation strategies was useful. A similar study to measure how the public's perception changes when presented with more information would be valuable, since it would inform the stakeholders as to whether they should be focusing more on winning public's hearts or informing public's minds.

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The view from the top

The decarbonisation imperative, aerospace supply chain challenges and the need for Europe to collaborate more deeply on defence were just some of the issues raised when Airbus CEO, Guillaume Faury hosted a media roundtable at RAeS HQ in January. **TIM ROBINSON** FRAeS reports.

▲ Airbus CEO Guillaume Faury in the Royal Aeronautical Society's Airbus Business Centre, No.4 Hamilton Place on 15 January.

It is remarkable that last year saw a fiery start to Airbus' 2024, when a JAL A350 widebody burst into flames after colliding with a Japanese Coast Guard Dash 8 on landing in Tokyo. Remarkably, despite the horrific images of the inferno and the five deaths aboard the turboprop, all of the A350 passengers survived – in the first ever hull-loss of an all-composite widebody airliner. While the words 'miracle' were much used, this is also a testament to Airbus' single-minded pursuit of safety. What could have seen the company dealing with difficult questions about its choices of advanced materials, instead saw the A350 pass the ultimate test with flying colours so far.

This crash also stands out in comparison to the non-fatal door loss of a Boeing 737 MAX – which, while a less dramatic incident, resulted in the US company plunged into a year of chaos, investigations and industrial action with its reputation in tatters as questions were raised about its quality control.

While Boeing reeled with this latest safety crisis, and strikes further halted production, this allowed rival Airbus to further extend its lead over its US rival. In 2024 it delivered 766 aircraft compared to just 348 in total from Boeing. Some 602 of Airbus' deliveries were its best-selling A320neo family – compared to just 260 Boeing 736 MAXs – with the runaway success of the A321neo, further allowing Airbus to widen the gap in civil airliners.

Airbus CEO, Guillaume Faury, talking to media at the RAeS HQ in London in January, summed up 2024 for the aerospace giant – which he described as a "quite difficult year but with a lot of successes". In January 2024, the company reorganised its senior management with a dedicated commercial team, headed by Christian Scherer, giving Faury the headspace to take a more holistic view across the entire group, which not only covers airliners, but also defence, space and helicopters.

At the roundtable, Faury laid out his main priorities for 2025 "starting with a full foot forward" which include dealing with supply chain issues, managing ramp-up and growth in civil airliner production, the sustainability agenda and the growing importance of the defence side of the business as the geopolitical situation deteriorates and becomes more dangerous. He stressed: "We continue to put safety, quality, integrity, compliance and security front and centre to all what we do".

Of Airbus' goals for 2025, he observed: "We basically still the same priorities. One is obviously delivering the ramp-up on all businesses, [particularly] the commercial aircraft business, where we have more than 8,600 aircraft on order." The second is "we obviously have a very important sustainability challenge with climate change, global warming, and what it means in terms of decarbonisation for aviation which is front and centre when we look at the midterm and the long term, that has not changed."

Finally, his third priority and a growing area of focus is "defence, space and especially the complex situation in Europe. There is a *Strategic Defence*

Review here in the UK, and a broader challenge for Europe and for the world to face the growing degradation of the security environment."

This, he explained, meant new pressures from defence customers looking to boost combat power as increased defence budgets are approved. Faury noted "against the backdrop of this degradation on the security environment they are challenged on spending more on defence. Obviously, at the moment they spend more, they want to spend better, and we want to find ways to create synergies to be better prepared to accelerate on a number of capacities." He added "that is really something that is taking more and more of my time. The balance of management attention between civil and military has really gone more towards military, given these challenges."

Supply chain woes

On the civil side, both Airbus and Boeing have had to deal with another year of supply chain issues, which are still rippling across the global aerospace industry. After Covid and P&W GTF grounding aircraft, the latest challenge saw LEAP engine maker CFM also hit by durability issues in 2024, as well as the impact from a hurricane in Florida – a situation that Faury admitted had 'blindsided' Airbus and is set to persist in the first months of 2025.

The upshot of this ongoing disruption was that the airframer has had to revise its delivery forecasts from 800 down to 770, and ended up handing over 766 aircraft by the end of the year. Said Faury: "even if we missed the initial guidance of 800, I'm really proud of what the team delivered last year... with all the difficulties that started to pop up."

These delays in airliner deliveries – as well as an extra three month wait for the eagerly anticipated ultra long-range A321XLR inevitably brought howls of protest from airline customers. Of this disappointment Faury said: "I take it as a positive sign. The day they don't want our aircraft and don't think we are late, it's really bad news." He added: "More seriously, I know there is appetite for for Airbus to ramp up."

> IF WE DECARBONISE, THIS INDUSTRY IS JUST AT THE BEGINNING OF ITS LIFE

Meanwhile, the shortage of new aircraft has put extra pressure on the cabin and retrofit side of the business, as airlines hang on to their fleet longer – adding additional complexity to the fast-changing and dynamic supply chain situation, said Faury. "For interiors, seats and so on, the issues are a bit more structural, because the lack of aircraft in the industry leads to more retrofits. So on top of a production workup, we have to face very strong demand for retrofits from the airlines themselves."

He added: "It's all about trying to organise a very deep and interdependent supply chain in an environment where you have a lot of individual disruptions that need to be managed. The number of crisises and the depth of some of the crisises we managed last year has been very significant, probably less in numbers than what we had in 2022-23 but were deeper and more difficult to solve, given the nature of the companies that were impacted."

Interestingly, on the supply chain side of things, Faury revealed that it is not just a lack of spare parts and aircraft that is the challenge – but a lack of human experts who understand supply chain chain management. He explained: "the most scarce resource that we have in companies today are brains and arms of people. We have few experts in each and every field, including in supply chain management. A lot of the issues we are facing, in my view, are linked to the underestimation of companies during Covid and of the value of the assets they had in supply chain management teams. They let a lot of people go that had a lot of experience and it takes a lot of time to rebuild that supply chain management knowledge."

One way in which Airbus is addressing this, he said, is deploying its own supply chain experts to suppliers to assist in removing these bottlenecks and reduce disruption.

▼ The Airbus A321XLR entered service in 2024 but has been affected by extra scrutiny by regulators in the wake of the Boeing 737 MAX crisis.

Airbus

Ramping up to Rate 75

Simultaneously, as the airframer grapples with supply chain issues and meeting current demand, it is also in the process of ramping up single-aisle production rate to a staggering 75 aircraft a month in 2027. Faury is quick to point out that the initial sales prediction of the A320, first launched in 1984, was for just 600 units in total at the time. The airframer now delivers around 600 A320 family aircraft a year. Faury recalls "when we decided to ramp up to Rate 65 before Covid, I spoke with Airbus veterans, who told me, when they went to Rate 45, their predecessors told them they would never go to Rate 45 – and then we went to Rate 55. I call it 'catastrophic success'. The production system was never designed for such a huge volume."

To that end he said: "We are preparing a production system that is a volume system, and it creates a lot of opportunities with more automation, more digitalisation, and probably some technologies on the production side that will be different, especially on carbon and composites, but also with metal, you can do different things. There will be less diversity on the parts and the brackets and things like this, as we are now in the volume industry."

However, he aims to give suppliers time to catch their breath: "The plan is to go to 75 and stay at 75 for some years," he added: "This is a prudent level of production in terms of being sure that the demand will remain higher than the supply for quite a while." This, he said, will "give time to the suppliers to also breathe some fresh air and rebuild their balance sheet – because when you are a supplier and you are in the ramp-up phase, you are actually contributing part of your balance sheet to the ramp-up. We needed a point in time to give to those suppliers time to stabilise and to rebuild the balance sheet, because we will then ask them to invest for the next-generation single aisle, which will enter service in the second half of the next decade."

Next-generation single aisle

On the A320neo's successor, the next-generation single aisle (NGSA) – the building blocks of which, such as super efficient wings and potentially the open-rotor RISE engine from CFM, are now under development, Faury explained that this would be launched "by the end of this decade." Would this, then, fall foul of any Trump trade war and risk reopening WTO launch aid wounds? He disagreed: "I expect that when we get to the point of investing in decarbonised technologies, Europe and the core countries will fully support investment, innovation and launch of new programmes. However, that's not something that is going to be a stick in the wheels in the short term".

Left unsaid however, if NGSA is set for EIS in 2037-8 this may mean that Airbus' more ambitious hydrogen-powered ZEROe airliner realistically will only appear in the 2050s. Admits Faury: "We spent a lot of money, time, effort, and employ a lot of good engineers on hydrogen because we believe in it, but it is not going to be the solution for the next 20 years." He observed that the interest in hydrogen has waned recently. "We see that the move to the hydrogen industry has probably been more delayed in the last 12 to 18 months rather than accelerated, and that's not good news for this initiative, so it's something we are monitoring very closely. We will be spending more time in 2025 understanding better the speed at which the hydrogen economy will grow, because we need a hydrogen ecosystem for a hydrogen-powered aircraft to enter service."

FCAS and GCAP collaboration

Given a more uncertain world, Faury's third priority is in the defence domain and he stressed the need for closer collaboration in Europe – and the need to consolidate both supply and demand – especially with a new US president pressing Europe to pick up more of the cost of its own defence.

While he shied away from calling for a full merger of the two rival future fighter programmes

Tim Robinson/RAeS

◀ Airbus Wingman UCAV mock-up at Farnborough Airshow in 2024. Could 'Loyal Wingman' be an area of collaboration between FCAS and GCAP sixth-generation fighter programmes?

Tim Robinson/RAeS

▶ Airbus CEO Guillaume Faury at a media roundtable at RAeS HQ last month.

– FCAS (France, Germany, Spain and Belgium) and GCAP (UK, Italy and Japan) he said: "We know that these systems will be complex, sophisticated and expensive to develop and then produce. So if you look at it in a very detached way, it is a scale game. So ideally, you would like everybody to join, at least in Europe, and to contribute to one system that will be scalable and standardised to a large extent to all players."

Outside of the core aircraft platforms he said there were big opportunities in terms of remote carriers/collaborative combat aircraft, combat clouds, engines and sensors where efforts could be more closely aligned. "It is a future combat air system with plenty of other dimensions, and I think there is really room to do things in a smart way" adding "It is not black and white. There are different ways of bringing those programmes together." He noted: "We are blocking ourselves from being creative if we think that it is either one or two".

However, the clock is ticking, he said, and European governments need to make choices soon: "we are in the technology phase, so we are not at the point where it needs to happen, but it is probably in the next couple of years that something that needs to happen if we want those programmes to come closer to each other."

Of the twin future fighter projects, Faury observed: "there are plenty of opportunities with GCAP and FCAS, to bring those programmes closer to each other, so that we don't spend all the money at once." He also maintained that consolidation needed to happen in Europe on a far wider scale – saying, "On defence programmes in general and space, we Europeans need to come together and create things at scale."

> "THERE ARE PLENTY OF OPPORTUNITIES WITH GCAP AND FCAS TO BRING THOSE PROGRAMMES CLOSER TO EACH OTHER, SO THAT WE DON'T SPEND ALL THE MONEY AT ONCE

He said: "If we take the example of the US Army, there are four types of helicopters. Apache, Chinook, Lakota and Black Hawk. However if you take France or Germany, they have ten. You've got an increased number of types, for a smaller number of helicopters. It's super fragmented. What Europe needs to do first is come together and create programmes at scale. Secondly, it needs to spend more money ad thirdly it needs to buy from Europe."

UK SDR

Meanwhile, with the UK heading for its own *Strategic Defence Review* this year, Faury laid out his wishes as one of the MoD's biggest suppliers of military equipment, including Eurofighter, A400M, and Voyager, as well as the upcoming Skynet 6A communications satellite: "What we would like to see is clarity, predictability, strategic thinking, because we are a long-term industry in defence, so we need clarity on intentions, on objectives, [and] priorities." He stressed: "I would expect, as Airbus, to see more consolidation of demand, therefore an appetite to work with partners and to be able to create things at scale, making good use of the taxpayers' money," adding: "we need to have priorities on the kind of technologies we want to master versus the ones that we are ready to share or even to buy".

On the UK as a whole, Faury observed: "we have a very strong relationship with the UK government, probably stronger than ever when it comes to commercial aviation and civil activities. The UK remains completely part of the industrial ecosystem of Airbus."

The biggest challenge

Finally, where then, does Faury see the biggest challenges to Airbus' commanding position in civil aerospace? A revitalised Boeing? Rivaly from COMAC or Embraer? Or a 'wildcard' like JetZero, developing a BWB airliner? Faury is clear on the biggest issue: "Decarbonisation. If we decarbonise, this industry is just at the beginning of its life. We have 25,000 airliners flying and we are serving just a fraction of what can be reached by aviation. That will continue to grow even with the challenges of climate change." He added: "The long-term potential for growth, if we manage [decarbonisation] decently, is … multiple times what we have today, and then there will be space for several manufacturers."

Finally, he reflected on Airbus' responsibility: "we have our future in our hands, and we want to be that solution to the future of decarbonised aviation. I think it is probably a privilege to be in that position in the industry, so you want to use that privilege appropriately."

Fight club

The 24th International Fighter Conference took place in November. **MATTHEW BARNARD** MRAeS highlights some of the key themes and briefings from the event.

"Air power is like oxygen. When you have enough, you don't have to think about it. When you don't have enough, it's all you can think about."

That quote was first given around a decade ago by Gen Frank Gorenc USAF (Retd), one of the two co-chairs of this year's International Fighter Conference. The three-day event, which took place on 5-7 November, brought together leading industry, academic and senior military personnel to discuss the current and future challenges and opportunities in the fighter arena. In doing so, it gave an opportunity to consider the wider geopolitical situation that militaries are operating in and certainly gave the 350 delegates much to think about.

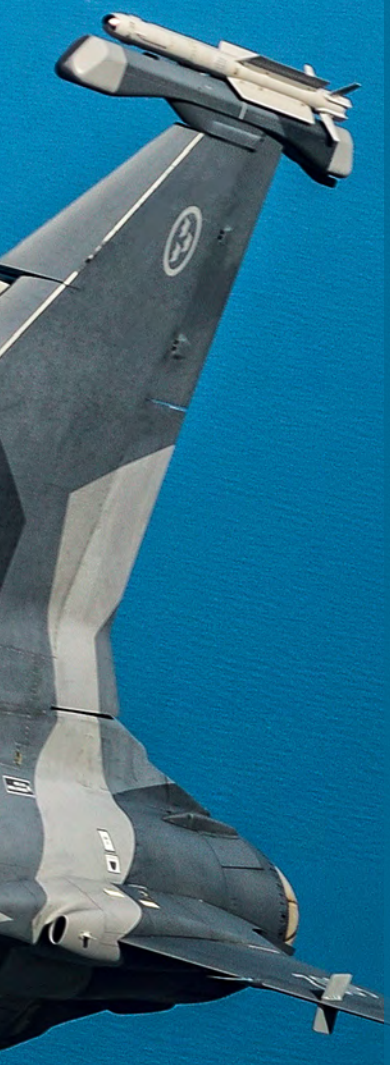
Alongside Gen Gorenc, ex-Luftwaffe Gen Klaus-Peter Stieglitz led and moderated the panel discussions and briefings, while also providing an opening *tour d'horizon*. He highlighted to delegates that Berlin is less than 1,000 miles by road from Kyiv and that people at the conference could make a difference in ensuring that operational readiness for deterrence among NATO and allied forces against current and potential adversaries is maintained and enhanced. Time was of the essence, he urged.

Future German Air Force

The honour of giving the first keynote briefing fell on the home nation, with the current head of the Luftwaffe, Lt Gen Günter Katz, discussing the future of the force. Gen Katz highlighted that the Luftwaffe was able to deploy Eurofighter aircraft to Romania on a "first responder" basis, thus enhancing NATO's air policing deterrence posture, on day one of the illegal invasion of Ukraine.

He also detailed the delicacy of conducting effective policing operations over NATO territory that lies adjacent to a conflict zone, in such a manner that it provides effective deterrence but does not become escalatory to adversaries.

Saab AB



Mission system software upgrade lead times for Saab's Gripen E are currently around one week with flight control system software updates taking two weeks.

Other themes touched upon by Gen Katz included an overview of the Pacific Skies 24 deployment that saw Luftwaffe combat air and support assets flown to the Asia-Pacific region, via the US, and take part in the Australian-based Exercise Pitch Black, alongside other NATO and allied nations.

Turning to the future, he highlighted that the recently announced new order of a fifth tranche of Eurofighter aircraft, the continuous upgrade of the existing Eurofighter fleet and the order of the F-35 aircraft all act as both a capability increase but also as stepping stones to the sixth-generation Franco-German-Spanish FCAS/SCAF programme.

This key stepping stone message was further reinforced by briefings given by both Airbus and Eurofighter representatives, as well as Maj Gen Jean-Luc Moritz, the French Armée de l'Air Project Manager for the programme.

Gen Katz concluded by highlighting other major challenges for the Luftwaffe, including the incorporation of AI into the defence realm (a commonly recurring theme at the conference), as well as ensuring young people entering the workforce are attracted to joining the military and there is a subsequent effort to retain them.

In conclusion, Katz emphasised that as individual countries lack sufficient combat mass, the interoperability between NATO members and allied nations is – and will continue to remain – key in ensuring effective deterrence effects.

Absorbing lessons

Professor Justin Bronk of the Royal United Services Institute (RUSI) provided insight on the conflict in Ukraine, together with associated lessons that are slowly being absorbed or relearnt by new and established NATO members.

He highlighted that, despite Russia's economy now being on – or close to – a full war footing, it is estimated that, logistically, in replacing its losses in equipment in Ukraine, it is close to the limit of its expansion in support of its current operations. As such, in the prosecution of the conflict, Russia now has a dependency on obtaining equipment from its supporting nations, with Bronk citing the estimated expenditure of anywhere between 1,000 and 2,000 drones in October 2024 alone.

Further, he highlighted that Russia's military personnel losses in Ukraine now exceed all those experienced by the US in WW2. Meanwhile, the structured deployment of third-party troops into the theatre of operations widens the geopolitical element of the conflict and indicates there are few red lines in Russia's prosecution of the conflict. In contrast, Europe, the US and their allies continuously cautious approach in their support of Ukraine was noted.

Turning to the lessons that NATO nations have taken on board since the invasion of Ukraine in February 2022, Bronk cited Finland's increase in inventory stocks to support and sustain its military as part of the country's "total defence and whole force deterrence doctrine." He also noted other NATO nations' increase in defence expenditure, especially the prompt switch of Germany's intended procurement of F-18 Super Hornets to Lockheed Martin F-35s. He also highlighted that both Sweden and Finland's accession into NATO strengthens the alliance's Northern flank and that both countries defence posture remains focused on a very singular objective, while employing a "mission command" ethos.

Finally, Bronk recalled lessons from the Cold War era where, in the face of overwhelming adversary ground forces, NATO airpower was seen as the key enabler in stopping Soviet armoured formations if they ever attempted to proceed over the North German plains. Today NATO's conventional deterrent remains heavily reliant on air power, including force multipliers, such as specialist aircraft that can perform Suppression or Destruction of Enemy Air Defences (SEAD/DEAD), as well as EW, air-to-air refuelling and AEW missions. Interoperability between these assets, and more widely the member nations of NATO in all domains, including space, remains key for an effective deterrence posture.

As one delegate elsewhere in the conference remarked: "In many ways it currently feels like we are rereading a book from 30 years ago."

Capabilities and challenges

During the conference, senior air force leaders – including those from Hungary, Australia, France and the US – highlighted common challenges, involving interoperability, logistics, agile dispersal/deployment of forces, manpower recruitment and retention considerations. There was also extensive debate surrounding the teaming and integration of future crewed and uncrewed aircraft, the level of autonomy afforded to the latter by machine learning/AI and the role of pilots (or more likely the emergent 'battle-space manager') in fourth, fifth and sixth-generation platforms.

Johan Segertoft, Head of Gripen – Saab (Saab AB)

These aspects were further expanded upon during a panel discussion, involving Marco Gumbrecht, Head of Sales Germany for Airbus Defence and Space, Gary North of Lockheed Martin, Maj Gen (Rtd) Jon Norman of RTX and Johan Segertoft, Head of the Gripen Programme for Saab.

To conclude the first day, Armée de l'Air Col Emmanuel Thomé, head of the combined Next Generation Weapon System (NGWS) team within the FCAS/SCAF programme for the French Procurement Agency, gave an overview of the multidomain aspect of the programme. This is designed to allow the interoperable linking of ground, sea, air, space and cyber-based systems to share data across crewed and uncrewed platforms, providing an effect-based capability in what is envisaged will be a highly contested threat environment posed by near-peer adversaries of the 2040s.

Enhancing capabilities

The second day of the conference kicked off with the Chief of Staff of Italy's Aeronautica Militare (AM), Lt Gen Luca Goretti, giving an insightful briefing on the capabilities that the introduction of the F-35 has brought to the force. Goretti emphasised that the F-35 is "an airborne sponge," that can gather, absorb and collate wide-ranging and copious amounts of data of the surrounding battlespace. It then has the capability to distribute that data to other platforms, thus transforming "situational awareness" into "shared situational awareness" across all platforms.

Lt Gen Luca Goretti, Chief of Staff, Aeronautica Militare

He also highlighted that having these advanced capabilities is only one aspect of ensuring that NATO and its allies can maintain its effective deterrent posture, adding that ensuring that data can legally be shared with allies and partners without restriction when flying together was essential.

Goretti also shared how the AM had refined its logistics to allow it to deploy quickly where necessary, citing a recent exercise where Italian F-35s were deployed to Australia within four days, with the requirement that on day four they were able to participate in exercises.

This provided a neat segway into a briefing from JR McDonald, Lockheed Martin's VP of Business Development for the F-35, giving an overview of the current programme. This included a summary of the issues associated with the Technical Refresh 3 computer processing electronics upgrade that is the essential precursor to the Block 4 capabilities for the aircraft. He also highlighted the remedies that LM have put in place to ensure such issues are not repeated downstream, including the investment of $350m in additional hardware and software development, as well as testing laboratory facilities.

McDonald also provided an update on operators use, mission rates and fleet build-up, citing for instance that today 19 global partners are flying or have ordered the aircraft, more than 1,000 aircraft have now been delivered and that by 2035 around 650 F-35s will be operated by 13 European air forces, as well as by the USAF and Britain from bases in the UK.

USAF Gen Kenneth S Wilsbach, Commander of Air Combat Command (ACC) also provided his views on how ACC was ensuring it continues to provide a credible deterrence. Air and space superiority (defined elsewhere in the conference as "that degree of control of the air by one force that permits the conduct of its operations at a given time and place without prohibitive interference from air and missile threats") is the key requirement for effective deterrence. Gen Wilsbach explained that having the ability to deploy an "other side of the horizon" long-range kill chain in the future will involve utilising, among other items, hypersonic missile and Collaborative Combat Aircraft (CCA) systems. He also added that ACC's high readiness and further development of its Agile Combat Employment (ACE) capabilities remain vital – as does its reliance on the defence industrial base's capacity and capabilities to support its mission.

Neglecting software? prepare for impact!

One of the most illuminating briefings of the conference was titled 'Neglecting Software? Prepare for Impact!' and given by Saab's Johan Segertoft. He opined that "although hardware still matters in keeping people and societies safe," in the transformational era we find ourselves in, "we cannot solve the problems of tomorrow with old methods." Therefore, software based platform adaptability is key.

By way of an example, he explained that his most recent car has had over twenty remotely downloaded software upgrades in two years of ownership and, arguably therefore, the car's performance and capabilities are better now

Matthew Bamard MRAeS

Matthew Bamard MRAeS

▼ Moderated by Gen Frank Gorenc (left) industry leaders, Maj Gen Jon Norman (RTX), Marco Gumbrecht (Airbus Defence and Space), Johan Segertoft (Saab) and Gary North (Lockheed Martin) discuss the imperative of close co-operation between industry, governments and their associated militaries.

Prof Justin Bronk of RUSI shares his views on current NATO Air Capabilities against potential threats while also discussing some lessons from the Ukraine conflict at IFC24.

Aeronautica Militare

Bundeswehr/Christian Timmig

▲ Left: Italian F-35s recently deployed to Australia for an exercise within four days.

Right: German air assets deployed to Australia in 2024 to take part in Exercise Pitch Black, alongside other NATO and allied nations.

than they were in 2022. He went on to highlight that the software upgrade cycle lead times for mission system applications on Saab's Gripen E are currently about one week, flight control system software lead time is about two weeks and computing hardware configuration lead time change is about four weeks.

In the Gripen E development and flight testing programme, Saab was installing a new software increment every two weeks and had close to zero software defects from the initial development flight onwards.

Giving two further specific examples, Segertoft explained how Saab has deployed updates to both mission and flight control software within eight hours and devised, developed and deployed a ground proximity warning software package in just eight weeks.

For the future, Saab wants to move away from any vision of "code in the morning, fly in the afternoon" and is aiming for a continuous software development cycle using machine learning from flight or mission data gleaned by either on-board aircraft systems or transmitted to the aircraft from off-board systems.

The company recognises that it may not know what requirements will emerge in the future that need a software generated solution, but also recognises that software development is exponential while hardware development remains linear. Thus, by ensuring that the Gripen's systems are built on an open architecture structure, are reconfigurable, that software testing is automated and simulated models are run concurrently to the on-board systems, mission and flight control software can be continuously updated. Segertoft concluded by pointing out that "software has no generations, only speed."

Naval air power

The conference concluded with discussions centred around the use of combat air power at sea. After a presentation by Capt Vincent Isorce, Head of Training for French Naval Aviation, Royal Navy Capt Edward Phillips explained the UK's view of naval power deployment and projection. Both captains stressed the joint international and interoperable aspects of their training and deployment rotations and also discussed how the unique combination of air power deployed from a carrier platform complemented air and sea power's individual domain strengths. They highlighted that while land-based air power allows for reach, speed and agility, it is non-persistent. The aircraft have a limited payload and require access, basing and overflight permissions when operating outside of sovereign territory. Meanwhile, carrier-based operations provide and compensate for all these land-based, air domain shortfalls, thus giving a carrier group unique and versatile capabilities in both freedom of movement and force projection.

Both Naval officers also highlighted some future developments centred around further interoperability capabilities. The French Aéronavale intends to employ the Dassault Rafale F5 variant, together with UCAVs, from its carriers in the future and the Royal Navy's Fleet Air Arm is looking to ensure cross operability certifications for its crews to fly, maintain and service other nations' F-35Bs, thus allowing an increase in flexibility when operating alongside the USMC and Italian Marina Militare.

In an ever-more unstable world, the role of combat air remains vital in ensuring that our adversaries wake up each morning and say to themselves "today is not the day." To move across the line, NATO and its allies need to maintain and enhance an effective and credible posture of deterrence. This involves not just the development and evolution of its aerial platforms and weapons but also software generated advances in artificial intelligence, machine learning and autonomous systems. In the words of Saab's Johan Segertoft: "The world will never again change as slowly as it does today."

Third runway set for take-off?

With the UK government potentially set to approve Heathrow's long-awaited third runway, **ALAN DRON** asks whether an ultimatum by its new boss has finally unlocked expansion.

For more years than anyone really cares to recall, the UK's London Airport has mooted the construction of a third runway to create desperately needed capacity for an airport that habitually operates at close to 99% of its capabilities. Now, the international hub's CEO has warned that if it does not receive a clear indication of government support for expanding the airport by the end of this year, it may walk away from the entire idea.

At a time of steadily increasing air traffic, that would effectively mean entering a period of managed decline compared to other European hubs.

After decades of prevarication by both main UK political parties, in 2015, an Airports Commission set up by the Conservative government, to come up with a definitive solution to the lack of airport capacity in the southeast of England, firmly opted for a third runway at the west London site.

Parliamentary approval was finally granted in 2018. There were inevitable environmental protests, but progress appeared to be being made, despite the project's cost of £14bn [See p32].

▲Rendering of Heathrow with its third runway.

Thrown off course

Then the pandemic arrived. With plummeting air traffic, the project was inevitably placed on the back-burner. However, with flight numbers now above 2019's level, the need for the third runway is once again front and centre – but how quickly could the Heathrow project be resurrected and put into motion?

The last Conservative government was distinctly lukewarm at the prospect of a third runway, noticeably keeping the entire idea at arm's length and stating that it was a matter for the airport and

▲ Chancellor of the Exchequer, the Rt Hon Rachel Reeves, and Heathrow Airport CEO, Thomas Woldbye.

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>
> **Thomas Woldbye**
> CEO,
> Heathrow

the private sector, despite having been the instigator of the Airports Commission that recommended the runway option.

The Labour Party – hostile to the idea of Heathrow expansion until shortly before the 2024 General Election – is now more positive about it.

As *AEROSPACE* goes to press, reports emerged that the government was about to give the green light for the third runway, as well as approve plans for Gatwick to transform its North Taxiway into a second runway and potentially press the 'go' button on an expansion of London Luton.

"We are committed to securing the long-term future of the UK's aviation sector," the Department for Transport told *AEROSPACE* in a written statement before the latest news broke.

"However, any expansion proposals must demonstrate [that] they contribute to economic growth, which is a foundation of this government's 'Plan for Change', while remaining in line with existing environmental obligations."

It will remain the UK Planning Inspectorate's responsibility to examine proposals on a case-by-case basis and provide a detailed recommendation to government.

Any application for a Development Consent Order (DCO) is the means of obtaining permission to construct and maintain developments categorised as Nationally Significant Infrastructure Projects – such as airport extensions – will be assessed against the relevant legislation and national and local policy, taking into consideration representations made by interested parties.

Pulled in different directions

Even if greenlighted by the Chancellor, the airport faces opposition from London's mayor, Sir Sadiq Khan and several London boroughs that fear increased numbers of flights will result in greater emissions and noise pollution for their residents.

All this indicates that there is potentially a lengthy bureaucratic process yet to negotiate. Heathrow was unable to provide a senior executive to talk about the project, but last December, Heathrow's CEO, Thomas Woldbye, told the BBC that he wants a strong indication of support for the new runway by the end of this year.

Woldbye said that he wanted "clear direction" from the government. "Is this [expansion] something that we strategically want from a transport national strategy point of view?" Is this what we want? Then what can we do to make it happen? What are the safeguards we need? I cannot see a company like ours investing that sum of money without having a clear steer and clear wish from government that strategically that is the right thing to do."

Woldbye told the BBC that, if there was no such clear direction, he believed that the third runway would not appear: "If the country doesn't want it, why would we build it?

The government has also been clear that they support airport expansion – exactly what and how that's defined we need to talk about – but those are two very positive messages."

The financial equation

The vast cost of the new runway and associated works would be paid for by Heathrow's owners – a grouping of international bodies, including French private investment company, Ardian; Saudi Arabian, Chinese and Qatari sovereign wealth funds; and the Australian Retirement Trust.

Also in December, Heathrow announced plans to spend £2.3bn over the next two years in an 'accelerated investment plan' to squeeze more productivity out of the existing facilities.

It should be noted that this figure is 'only' an increase of £233m over previously announced investment plans for the airport. The funding will be used "to enhance capabilities across all terminals, including baggage delivery and projects to support punctual departures and arrivals."

"Heathrow is the best-connected airport in the world," an airport spokesperson said. "That competitive advantage for UK plc already enables over £200bn of British trade annually. But growing the economy means adding capacity at the UK's hub airport which is full.

"That's why we're planning to unlock capacity by improving and upgrading our existing infrastructure, while also looking at potential options to deliver a third runway at Heathrow in line with strict tests on carbon, noise and air quality.

"Critically, Heathrow's increased investment serves to support the government's national mission for growth. To deliver the UK's industrial strategy and support industries that rely on Heathrow's global connectivity, it is critical that the UK's international

A history of proposed London airport expansion

Plans for increased airport capacity in southeast England have been around since the 1960s. 'London's third airport' was originally mooted for Cublington, Buckinghamshire, only for the site to be rejected in 1971 by the Roskill Commission, which instead opted for a site in the Thames estuary at Maplin Sands, sometimes also known as Foulness.

That plan was abandoned in 1974 when the new Labour government came to power. However, the Thames Estuary has remained a favoured site for a new London airport – the most recent incarnation being the proposed man-made 'Boris Island,' which pandered to the former Prime Minister's hostility to the thought of expanding capacity at Heathrow.

In some ways, a Thames Estuary site is a better choice, operationally, than Heathrow, if only because there are fewer people to disturb. However, the cost of creating an artificial island, all the necessary infrastructure and what would be the essential, but fiendishly costly, fast transport links from London, have always proved insuperable.

The Thames Estuary also brings with it a significantly greater risk of fog than at existing airports and the relative proximity of Amsterdam Schiphol would also lead to potential difficulty with clashing flight paths.

A major problem for governments of all stripes is that putting a new airport anywhere in the UK, but particularly the overcrowded southeast corner, will always brings howls of protest from both local residents and environmental interests.

For this reason, expanding the existing site at Heathrow is arguably the least worst option.

The Airports Commission, set up by the coalition Conservative/Liberal Democrat government to provide an independent, definitive verdict on the nature of new airport capacity in the southeast, opted in 2015 for a third runway at Heathrow.

After much profitable work for the legal profession in handling objections and appeals in sundry hearings, in December 2020, the UK Supreme Court finally came down in favour of allowing the proposed third runway to proceed.

The new runway would be northwest of the existing two east-west aligned landing strips.

The Airports Commission's report estimated that the new runway would provide the capacity for around 40 new destinations from the airport and generate £147bn, as well as more than 70,000 new jobs by 2050.

The price tag is huge – an estimated £14bn. This covers not only the runway and its immediate surrounding infrastructure, such as taxiways, but potentially rerouting London's M25 orbital motorway, which runs round the western edge of the airport, through a tunnel under the new runway. It will also require razing the village of Sipson outside the airport's current northern perimeter.

The proposed cost also outraged airlines, which accused Heathrow of 'gold-plating' the project and thus inflating the price.

The next step for Heathrow – if it decides it has enough support from government – will be to start the (lengthy) planning application process for the new runway. Just how long this will take remains uncertain.

An artist's impression of the proposed Thames Estuary airport from the last decade.

Heathrow

gateway for trade and tourism is fit for the future."

The statement added that the airport had invested £1.1bn in facilities or improvements in 2024.

Is there a commercial rationale for a third runway? "It would be a very expensive runway because it involves not just the runway but reconfiguring road routes as well," noted Becrom Basu, a partner in strategy consultants LEK's transport practice in Europe. Nevertheless, he said, Heathrow remains a premium location and airlines do want to fly out of it. So, the commercial case is probably still valid.

"I would have thought that if it goes ahead, investors would still find it a good investment. There's a lot of pent-up demand there – the airport is running at 95% capacity.

> "I WOULD HAVE THOUGHT THAT IF IT GOES AHEAD, INVESTORS WOULD STILL FIND IT A GOOD INVESTMENT. THERE'S A LOT OF PENT-UP DEMAND THERE - THE AIRPORT IS RUNNING AT 95% CAPACITY
>
> **Becrom Basu**
> Partner, LEK

Wider issues at play

"If you then think about the environmental rational, there's always a bit of an issue trying to demonstrate you're doing the best you can in terms of emissions."

Previous objections "have included surface transport and emissions: I think that will be overcome. Investment would involve sorting out road access." While that would be immensely complex, it would give the developers the opportunity to improve overall road access in the area, as well as the necessity of realigning the M25 motorway and all its surrounding roads: "You would make sure you have a decent road configuration for road access to the airport."

Heathrow already has very good rail connections, which are 'green', Basu noted. "There's also an ongoing decarbonisation of road transport; for example, Uber is aiming to be all-electric in a couple of years." And, as more motorists gradually opt for electric vehicles, pollution problems (if not road congestion) should start to diminish.

As for emissions from the aircraft themselves: "That's where we start to get into trickier discussions about what's the right thing to do."

Despite environmental concerns, "one school of thought is that if people want to fly, they'll find a way to fly." While many people might opt to fly from other airports, such as Birmingham, or even take a flight from a UK regional airport to connect with long-haul services from Amsterdam Schiphol or Frankfurt, such a course of action could arguably actually lead to more emissions being generated.

In terms of overall connectivity, more capacity at Heathrow will drive that up – much more so than at Gatwick, he noted, which remains primarily a point-to-point airport.

Much of the Airports Commission's decision to back the third runway at Heathrow was founded on the fact that a third runway there "would drive connectivity in a way other options wouldn't."

Sustainability

Airports have increasingly felt the necessity to demonstrate their 'social licence' to justify their activities in the face of environmental complaints.

Heathrow, of all UK airports, is quite well-positioned to do this, Basu said. Around 45% of all jet fuel sold in the UK goes through Heathrow, so anything the airport does to encourage the adoption of SAF has a significant impact and the airport is working to bring in SAF supplies.

Basu declined to comment on Woldbye's stance, but noted that Heathrow has invested considerable time and investment in trying to create a third runway. "Maybe at some point they just want to stop spending the time, but it's not that the [business] case would go away after 2026."

One other option in the Airports Commission's report was the creation of a third, shorter runway. "A big chunk of the money [will be spent on] sorting out the M25," Basu said. "Another chunk will be for a new terminal. The shorter runway option helps with the road network, but compromises the capacity."

The Breakfast Club

As a new president is installed at the White House and surrounds himself with self-made tech billionaires, **BILL SWEETMAN** asks what the self-proclaimed 'First Breakfast' group means for defence spending.

"We see elevated uncertainty for US defence sentiment," veteran defence market analyst, Byron Callan of Capital Alpha Partners remarked in a letter dated 18 December 2024. That is putting it mildly.

President Donald Trump was sworn into office on 20 January, among rising global tension. His cabinet nominations have reflected his team's desire to pursue social issues including deporting undocumented migrants.

However, Trump's cabinet picks have been overshadowed by the appointment of the world's richest person, Elon Musk. The CEO of SpaceX, Tesla and social media platform, X (formerly Twitter), Musk once maintained a non-partisan image – SpaceX and Tesla owe a lot to the Obama administration – but between July 2024 and election day he donated an estimated $250m to the Trump campaign.

▲ Left to right: Peter Thiel, Elon Musk and Palmer Luckey.

Getting the most out of DOGE

Along with fellow billionaire, Vivek Ramaswamy, Musk has been rewarded with a new Department of Government Efficiency (DOGE), tasked with cutting the $6.75tn (2022) federal budget. He has also been a constant presence at Trump's Florida mansion and accompanied the (then) President-elect to the reopening of Notre-Dame cathedral, his first post-election meeting with foreign leaders.

Vice-President, JD Vance has long been in the space mogul's orbit. Peter Thiel, Musk's partner in PayPal and other ventures, launched Vance's political career in 2021. Vance has been overshadowed by Musk since the election, but his importance resides in Trump's age.

Late in November, Musk vigorously criticised Lockheed Martin's F-35 programme on X, saying it was "broken at the requirements' level… an expensive and complex jack of all trades, master of none" and crewed fighters "will just get pilots killed."

This is not an empty threat: start-up defence company, Anduril, which was awarded one of two Collaborative Combat Aircraft (CCA) contracts in April, was co-founded by Thiel. Moreover, a group of new defence leaders, including Musk, Thiel and Anduril, co-founder Palmer Luckey, are planning to 'reboot' the defence enterprise. The CTO for Thiel's company, Palantir, published *18 Theses for Defence Reformation* just before the election, calling for an end to 'cost-plus contracting' and a move away from pure-play defence prime contractors to mixed commercial-defence enterprises… like Palantir and SpaceX.

USAF

▶ Musk has lambasted the F-35. Is the programme safe by virtue of the amount of jobs it supports?

First Breakfast

The revolutionaries have adopted the name 'First Breakfast,' because they believe that the rot set into defence after the 1993 'Last Supper' dinner meeting, where President Bill Clinton's Deputy Defence Secretary, Bill Perry directed industry leaders to consolidate or perish.

First Breakfast will deal with Trump's Pentagon leadership. His nominee for Defence Secretary, TV news host, Pete Hegseth, has so far weathered revelations about misconduct and heavy drinking. Lower-tier nominations lean towards financial backgrounds, with little experience of industrial management and none of engineering or military command.

Stephen Feinberg, nominated as Deputy Secretary, is CEO of Cerberus Capital Management, a private equity firm that has invested in hypersonic technology. Michael Duffey, nominated as Undersecretary for Acquisition and Sustainment, has held defence-related staff positions since the early 2000s and was a member of Trump's transition team.

Important to US industry, the post of Undersecretary for Research and Engineering has been awarded to Emil Michael, formerly a senior executive for Uber, and also with an investment background. At one time he was a member of the Defense Business Board, created to provide independent advice to the Pentagon. Meanwhile on 16 January, it was announced that Principal Deputy Director of the National Reconnaissance Office, Dr Troy E Meink would be the new Air Force Secretary.

The revolutionaries will also have to confront the military-industrial-congressional complex, deeply rooted in every state – particularly in the Trump-leaning South – and wired together by law and contracts.

Contracts to cancel?

Musk's calls to cancel the F-35 are unlikely to gain traction. The Joint Program Office wrote $36bn worth of contracts in 2023 alone, much of it supporting well-paid industrial jobs. Politicians do not want to trade those for First Breakfast's robotic giga-factories.

There are no other production lines available to build enough fighters to stop, let alone reverse, the ageing of the USAF's fleet. There are no alternative fighters for the US Marine Corps, which is historically invincible on Capitol Hill. Likewise, it will be hard to trim the US Navy's fleet plans, built around its carrier strike groups. Shipbuilding also supports hundreds of thousands of jobs, mostly in areas with few, if any, industrial employers on the same scale. Defenders of the status quo may point out that construction docks that are closed will be unlikely to reopen.

Anduril

▶ Anduril, which was awarded a US Collaborative Combat Aircraft contract in 2024, was founded by First Breakfast members, Peter Thiel and Palmer Luckey.

▲ The USAF's current mixed fleet of fighters and bombers could be called into question with Musk suggesting crewed airframes "will just get pilots killed."

However, if the First Breakfasters persist, and doubly if Trump does not complete his term and Vance is in position for a ten-year presidency, they will have more time and power than earlier reformers, enough to make some ideas stick.

Advancing agendas

This could be an opportunity for service leaders, chafing against bureaucratic management within the upper levels of the Pentagon and the Office of the Secretary of Defense, and frustrated with the major prime contractors' dogged defence of their current business, to advance their own agendas.

At a November forum on the future of the USAF organised by the Air Force Association's Mitchell Institute, Anduril and other First Breakfast-aligned companies were well represented in panel sessions. The floundering Next Generation Air Dominance (NGAD) programme – a decision on which was finally deferred to the new administration later in the month – was hardly mentioned, nor was much said abut F-35. There was strong support for CCA, for building more Northrop Grumman B-21 Raider bombers and for ideas, like constructing a larger inventory of lower-cost, long-range missiles.

Could the services be sold on the idea of losing or cutting back some programmes, as long as the money is diverted to new and promising initiatives? The F-35 was to some extent foisted on the USAF by Bill Perry to enforce his Last Supper mandate. The B-21 was the result of a largely covert campaign by air power zealots, opposed by ground force generals and admirals. Redirecting resources from the F-35 and other overrunning programmes (even the Sentinel ICBM) into a force centred on bombers and bomber-launched weapons might seem attractive – and more so, if the First Breakfast revolutionaries take the heat for it.

Revolutions are often bad for bystanders, and Britain and other allies need to keep a close watch on the views of the tech billionaires. There is a strong thread of 'America First' in their politics and Musk is no friend of Europe and its desire to restrain monopoly powers.

If there is a slowdown in funding for the F-35's continuing modernisation, integration of British baseline weapons, SPEAR 3 and Meteor, will recede even further. A budget that is focused on accommodating new US contractors will not be friendly to imports or joint ventures. The AUKUS project leaders will be well advised to make sure that overruns do not look like a burden on the US. Ultimately, if US global strategy veers from alliances in favour of democracy to *realpolitik* and acceptance of dictatorships, the fact that vital functions of the F-35 are coordinated by software updates from a US-owned lab at Eglin AFB could become problematic.

A final caution. Technology leaders, like Musk, may have made machines and made fortunes, but they are not known for understanding how people work, and politics is about people. As the US defence community buckle up for a turbulent era, it is worth reminding ourselves that revolutions and reformations seldom, if ever, go the way their instigators expected.

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How just is your culture?

Reflecting on a collective failure that saw a brand-new RAF Voyager MRTT damaged, AM **SEAN REYNOLDS** asks how just is your culture?

It was 19 December 2014. I was coming to the end of my second year as Air Officer Commanding Number 2 Group, responsible at that time for the RAF's Air Mobility Force (AMF), Search and Rescue Force, Force Protection Force (RAF Regiment and RAF Police) and full command oversight of the RAF Support Helicopter Force.

I was also one of the first Operational Duty Holders (ODH) that, post-the Haddon-Cave report and advent of the Military Aviation Authority (MAA), had been made personally and legally accountable for all safety decisions within their area of responsibility. This seemed empowering and terrifying in equal measure!

We had also just successfully completed one of the most intense periods of sustained operations for the RAF's Air Mobility Force – the transition and redeployment of UK forces from Afghanistan, a landlocked country that required most of our people and high-value materiel to be moved by air. During the same period, we had retired the Vickers VC10, Lockheed TriStar, Hawker Siddeley HS125 and Lockheed C130K aircraft, while concurrently bringing the Airbus Voyager MRTT and A400M Atlas into service. It had been a busy year and we were all looking forward to the Christmas break.

▼ The hangar was on the opposite side of the aircraft to the captain, who was sitting in the left hand seat. The Voyager sustained severe and avoidable damage.

> MY INCREDULITY RAPIDLY TURNED TO DISAPPOINT-MENT AND EXTREME IRRITATION THAT ONE OF OUR SHINY NEW AIRCRAFT LOOKED LIKE IT HAD SUSTAINED SEVERE AND COMPLETELY AVOIDABLE DAMAGE

Hangar crunch

I was sitting in my office when my Senior Operator (SO – my adviser and lead on all air safety matters) walked into my office and informed me that we had been notified of a ground incident with one of our brand-new Voyager aircraft at St John's, Newfoundland.

At first my reaction was that this was not completely out of the ordinary but, when he produced the photographs, my jaw hit the floor. There was a picture of a Voyager wing buried in the side of a very large hangar.

My incredulity rapidly turned to disappointment and extreme irritation that one of our shiny new aircraft looked like it had sustained severe and completely avoidable damage.

All of my emotions were now telling me to get the squadron commander on the phone and demand an immediate explanation, followed by the summary disciplining of the aircraft captain and crew. After a number of unrepeatable military expletives, my SO said: "Boss, why don't we just sit on our hands and wait for the initial investigation to tell us exactly what happened?" He reminded me that I had been espousing 'Just Culture' and that maybe we should follow the process in our newly published Safety Management System (SMS) and 'walk the talk'.

Stakeholders

That said, I knew that in this now highly connected world, it would not be long before the incident became public and there were a number of external actors and stakeholders that I would quickly need to manage.

I had a quick chat with the Station Commander at Brize Norton, who was equally aghast but shared our view that we should follow the SMS if we were serious about our evolving Just Culture. He agreed to talk to the squadron and crew and let them know that we would let the initial investigation inform our decisions and that we would not rush to judgement.

I also spoke to the MAA and told them what our intentions were which, of course, was fully supported. I then took the long walk to the Chief of the Air Staff's office, armed with the photographs and my carefully rehearsed explanation of what I intended to do.

Suffice to say, it was not an easy conversation but, under the new MAA regulatory construct as the ODH, the accountability first lay with me and not with him. He could of course overrule me but that would be 'rather nuclear'. I remember being told that he would want a full report once the facts had been established.

The other key factor in all of this is that the aircraft were owned and supported by a company called Air Tanker Services as part of a Private Finance Initiative. This meant that all of the operational support and most of the engineering support was provided by them from their brand-new facility at Brize Norton. In transitioning to this new delivery model, we had adopted an operating concept of 'civilian' when conducting routine flying (such as air transport) but 'military' for flying,

Crown copyright

such as air-to-air refuelling (AAR). All of this was enshrined in the Voyager Operations Manual (VOM), which was a key constituent of our SMS, and would be completely recognisable to a civilian commercial operator but, at the time, very new to the AMF and the RAF.

The results

So, what did the investigation tell us? The aircraft had been conducting a routine Extended Range Twin-Engine Operation (ETOPS) training flight to St John's, Newfoundland. We needed to do this because, for the first time in its history, the RAF was operating a twin-engine aircraft over oceanic distances. Unlike airlines, we did not have the frequency of routine oceanic crossings under which to conduct the necessary number of training sectors to get enough crews trained to stand up the capability in a timely fashion. So we generated a number of bespoke training flights and the shortest distance in which to do this was from Brize Norton to St John's – which was one that we could do as a round trip without overflying our crew duty periods.

For the flight in question, the crew were directed to the cargo ramp – rather than the usual passenger terminal – for the turnaround because of some airport congestion. Furthermore, there was work in progress on the normal taxiway that we used and the aircraft would need to access the ramp by a different taxiway. Although this was known, the crew were unaware that this could be a factor.

> WE HAD INADVERTENTLY PLACED THE AIRCRAFT CAPTAIN IN A PRECARIOUS SITUATION

This is where the first hole in the Swiss cheese model appeared and should have started ringing alarm bells with the flight planners. At face value this seemed routine and something that we had been doing regularly with the legacy aircraft types, such as the VC10 or TriStar. However, Voyager is based on the Airbus A330-200 and, as such, has a much larger wingspan.

Critical factors

The next subtle – but critical – factor was the way in which the training was being conducted. As previously alluded to, we were now adopting an approach of 'civilian' and 'military' flying. In the civilian world, the training/check captain regularly occupies the jump seat on the flight deck and is not the aircraft commander. This was fundamentally different from the operating culture that the AMF had been used to over recent decades and the captain on this occasion was a very experienced and well regarded VC10 operator.

On arriving at St John's, the aircraft was directed to the cargo ramp. However, the crew became worried about the proximity of a hangar to the taxiway and stopped the aircraft and requested a marshalling team with wing walkers. The next factor was the setting sun which was now directly behind the aircraft and into which the marshaller was now squinting. As the aircraft now moved forward, both wing walkers were giving a thumbs up that the wing was clear. This was confirmed by the co-pilot and training captain as the hangar was on the opposite side of the

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aircraft to the captain who, positioned in the left hand seat, could now no longer see the hangar and believed that the training captain had now taken responsibility for the aircraft clearance. The next critical factor was that the taxiway curved to the left. This resulted in a phenomenon known as swept wing growth. When a swept wing aircraft, like Voyager, turns on the ground, the wing tips geometrically travel further. This was now happening. Finally, when the wing walker realised that a collision was imminent and signalled for the marshaller to stop the aircraft, the marshaller did not see the signal as he was now blinded by the setting sun. The crew then felt a large jolt as the wing collided with the hangar.

On reading the initial report, I had to admit to feeling a degree of personal embarrassment and thanked my SO for his wise counsel. This was clearly as much a system failure as a human failure. Yes, ultimately, the marshaller should have stopped the aircraft if he was not satisfied that he could clearly see the wing walker's signals – but we had inadvertently placed the aircraft captain in a precarious situation. If we had properly scrutinised the taxiway leading to the cargo ramp we would have seen that there was an issue with wing clearance. Why had this not been promulgated as unsuitable for A330s?

We had culturally fallen into the trap with regard to the conduct of training. Behaviourally, we had a captain who was used to the training captain being the designated aircraft commander with ultimate responsibility for the safety of the crew. So, when assured that he was clear by the training captain, he had reverted to a bias that we had ingrained in him over many years. That said, he had done exactly the right thing in requesting a marshalling team. However, it appeared that they were not used to handling an aircraft of that size, on that taxiway and with the attendant swept wing growth issue.

> WE HAD NOW CREATED A BETTER, SAFER AND MORE JUST CULTURE IN WHICH PEOPLE FELT COMFORTABLE IN REPORTING AND HIGH-LIGHTING POTENTIAL SAFETY HAZARD

As I mulled over what I was reading I had to decide what to do. I convened a meeting of my safety working group at which we realised that we had allowed the holes in the cheese to line up and had failed to avoid, trap and mitigate the risks. However, we also realised that we had an opportunity to learn, pause and take stock of what it meant in introducing an aircraft with a fundamentally different capability and a new and unfamiliar operating model. Most of all it allowed us to explicitly live the value of Just Culture.

In the following days we were very public in confessing that this was fundamentally a system failure, that a different crew with the same experience and in the same circumstances could, on balance, have had the same outcome and that it was as much our fault as the crew in question. It had been a collective failure.

Suffice to say that safety occurrence reporting in my area increased by more than 300% over the next six months. When challenged by my boss that I clearly had a safety issue in my group, my response was that the occurrences had always been there but that we had now created a better, safer and more Just Culture in which people felt comfortable in reporting and highlighting potential safety hazards.

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If war should come...

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As the UK looks towards the upcoming *Strategic Defence Review*, Dr **DAVE SLOGGETT** considers the gaps in Britain's air and missile defence.

There are many uncertainties about what priorities will shape the outcome of the current *Strategic Defence Review* (SDR) being undertaken by the UK Government. With so many challenges appearing on the world stage, where to focus what will obviously be a restricted defence budget is central to the undertaking.

It is almost inevitable that, whatever the outcome under the current fiscal pressures in the budget, and the high level of national debt after the expenditures on the Covid pandemic, some military capabilities will be retired or donated to Ukraine. In turn, this will pave the way for new capabilities to be introduced that are linked inexorably to the lessons emerging from the conflict in Ukraine and what is occurring around the world as Russia, North Korea and Iran seek to unravel the international rules-based order and create an ever-more unstable multipolar world.

Day after day, hour by hour, Russia indiscriminately pounds Ukrainian cities and its critical national infrastructure (CNI) with drones, cruise missiles and ballistic missiles supplied by its allies, while Hezbollah and Hamas missiles target Israel and Houthi missiles attack maritime shipping in the Southern Red Sea and Arabian Sea. Meanwhile, China and North Korea regularly fly ballistic missiles over the airspace of South Korea, Taiwan and Japan in intimidating profiles.

It is interesting to observe that, whereas once the technologies behind ballistic missiles were the purview of a small number of state actors, proliferation of those technologies has seen non-state actors gain capabilities that were previously beyond their reach. This is a trend that is unlikely to end, the rapidly diversifying threat from drones being a case in point. Compounding this, other, more complex, threats are emerging.

Lessons from Ukraine

Of all the conflicts that are currently occurring around the world, it is the one between Russia and Ukraine that is the most lethal. As the 1,000th day of the war passed, Russia further escalated its indiscriminate attacks against the Ukrainian population and its energy infrastructure with the use of an intermediate range ballistic missile (IRBM) for the first time.

When Russia flies its routine aggressive packages of aircraft towards the UK, they invariably contain a mix of strategic launch aircraft, tankers, AEW platforms and escort fighters

Based on the RS-26 Rubezh, the new Orshnik IRBM delivers its warhead via the atmosphere at a significantly higher speed than any of the threats used by Russia thus far, such as the Iskander and Kalibr missiles. Even contemporary Western-sourced air defence systems will be stretched to engage such a warhead on a hit-to-kill basis where closing speeds are measured in terms of kilometres per second.

While the Russian use of the IRBM is a harbinger of the future threats an upgraded UK air defence system will have to address, the immediate focus needs to remain on the threats from cheap, low-flying drones (individually and in swarms), long-range cruise missiles and the shorter-range ballistic missiles.

For a country whose existence after World War Two can be traced to the deployment, in peacetime, of a unique air defence system, the current paucity of the UK's air defence capabilities is disturbing, given the diversity of the immediate threat.

Lessons from Israel

Aside from Ukraine, it is not hard to also see vital insights emerging from Israel. That nation's approach to its air defence can be summarised along two lines: attack the supply lines used by its adversaries to obtain missile technologies and develop a national indigenous capability able to shoot down those threats when they emerge. By any scale, the Israeli Iron Dome system is impressive and in recent attacks mounted by Iran the system achieved success rates close to 98% – far beyond that which might be reasonably expected.

However, those who advocate a simple patch to our own situation can be found by buying the off-the-shelf capability from Israel fail to understand the way the threat is emerging. Even Israel has had to be supplied with the US Terminal High Altitude Air Defence (THAAD) system to address ballistic threats. It is almost inevitable that any future UK air defence system will need to add a capability, such as THAAD, as an overlay to the current capabilities.

QRA and Sky Sabre

Today our air defence capabilities can be drawn along two lines. The first comprises a small number of RAF Typhoon fighters on Quick Reaction Alert (QRA), able to be deployed to fly to the outer reaches of the UK Air Defence Region (UKADR) and intercept threats before they can launch stand-off cruise missiles, such as Kalibr with over 1,000km range. The second line of defence is the Sky Sabre system which has replaced the long-serving Rapier as a point-defence system. It is reportedly able to engage 24 targets simultaneously.

While this is impressive in terms of the large-scale swarms Russia has been sending into Ukraine on a daily basis, its increasing ability to manufacture more cheap platforms makes for bleak reading. UK production of Sky Sabre would have to go onto a war footing if we were to be able to cope beyond two or three days of all out war.

Supporting this front-line defence is a chain of fixed radar systems, based along the eastern coastline to the far north of the Shetlands at RAF Saxa Vord on the island of Unst. This fixed radar station was decommissioned in 2006 only to be recommissioned from 2017 in the wake of the growing threat from Russia. RAF Saxa Vord does not exist in isolation. A NATO early-warning radar system located in Norway provides plots and tracks of any potentially threatening aircraft operating out of Russia's northern airbases, giving additional time to deploy a response. These radars, however, are based within a few kilometres of the Russian border and, therefore, unlikely to survive an initial Russian onslaught on NATO.

This is only one of the challenges facing the air defence of the UK at this moment in time. The fixed radar sites along the eastern coastline can all be seen on *Google Earth*. Targeting them is, therefore, relatively straightforward.

Whereas historically UK air defence systems, such as the UK Air Defence Ground Environment

▼ From left to right:

Russia test fired a Yars ICBM from the Plesetsk launch pad Russia in March 2024.

The UK Typhoon force stands on QRA 24/7 from bases at RAF Coningsby and Lossiemouth.

It is possible to envisage a time when the RAF Wedgetails are escorted by CCAs.

Russian MoD

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Boeing

(UKADGE), had a mix of fixed and mobile assets, the current systems are extremely vulnerable to a pre-emptive attack.

One of the key lessons to emerge from the conflict in Ukraine was that the increased threat Russia posed to Ukraine enabled the military command in Kyiv to disperse its Russian-supplied air defence assets, ensuring their survivability and continued operation.

Enter Wedgetail

Plans to deploy a new Airborne Early Warning (AEW) capability, to replace the Boeing E-3D Sentry aircraft which were decommissioned in 2021 after 30 years' service, have also been scaled back. What was supposed to be a purchase of five Boeing E-7 Wedgetail platforms has been reduced to three. How long they would remain operational given the way the air threat is emerging is an important consideration.

When Russia flies its routine aggressive packages of aircraft towards the UK, they invariably contain a mix of strategic launch platforms for their cruise missiles, such as the Tu-160 Blackjack or the Tu-95 Bear, long-range tankers, A-50 Mainstay AEW aircraft and MiG-31 Foxhound escorts. This mixed package provides long-range sensing, air defence and air intercept capability that protects the strategic launch platforms. Given such a threat, detecting and neutralising the new UK AEW capability before they take off or when they are deployed is likely to occur fairly quickly.

The current state of affairs is clearly not sustainable or survivable beyond the first few hours of a wider conflict with Russia, a possibility that, given the rapidly escalating events in Ukraine, has to be given serious consideration. With UK Storm Shadow missiles now attacking key logistics nodes inside Russia, the potential for a wider war to develop must be higher. In that event, surely we will need to rely on an air defence system that is flexible and survivable.

Given that this is an obvious conclusion from the current SDR, what might the architecture of such a new system look like? Clearly the basic elements of the Home Chain system deployed before WW2 remain essential. Long-range sensors have to be linked via a command-and-control system to provide the fused air picture of threats to the UK airspace that gives the situational awareness from which Typhoon fighters and their support in-flight refuelling aircraft to be deployed on Combat Air Patrol (CAP) missions to meet the threat at the furthest possible range from the UK.

Potential for escalation

With the conflict in Ukraine changing views on the nature of conflict in the air, arguably the most serious insight is the nature of the mixed threat that Russia can deploy against the UK. The use of mass-produced drones in swarm attacks, against our CNI, such as power stations, ports and military logistics hubs, is to be expected. While individually each drone that penetrates the air defence capabilities cannot do extensive damage, Russia's escalation to the use of conventionally armed intercontinental ballistic missiles represents a step-change in the threat.

The assembly and deployment of any air defence system is a balance of a number of trade-offs, of which, cost is one factor. However, another key consideration is what does an air defence system protect? When threats travel increasingly faster, the footprint that a defence system can protect shrinks. With the speed of re-entering warheads from ballistic missiles, this can become vanishingly small where protected areas are measured in terms of a small number of square kilometres.

In such a situation protecting a city is challenging. It is almost inevitable, given current technologies, that any defence against such a plethora of threats will have to be based on specific priorities, such as energy and telecommunications hubs. Without power or communications our society will rapidly descend into chaos. However, even this is difficult as the engagement windows narrow so quickly that human intervention in the decision to engage threats

▼ Sky Sabre is composed of three main components. The surface to air missile command and control element, the Giraffe agile mutli-beam radar sensor and the Land Ceptor launcher and missile.

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▲ RAF Saxa Vord was closed in 2006 but reactivated as a Remote Radar Head facility from 2017.

becomes almost impossible. This suggests that many decisions on threat engagements will have to be automated. Those decisions will have to be informed by situational awareness derived from the assembled air picture that has all the hallmarks of the fused information assembled 85 years ago by those involved in the Battle of Britain.

Whereas those radar sensors were manually operated, the next generation of air defence sensors systems will have to include some elements of AI using variable threshold (rather than fixed) detection algorithms to detect and track threats in a hostile electronic counter-measures environment. Jamming, in a future conflict, is likely to be an escort to the threats rather than operate in a stand-off mode. This will require radar sensors to evolve from their current capabilities.

It is not just in the sensor arena where the next generation of air defence systems will have to become smarter. Increased survivability of the air defence assets is the of the future. This applies in the air and space, as well as the naval domains.

Royal Navy ships, while armed with the very effective Sea Viper system, are easily exhausted by swarm attacks. Recent open-source reporting suggests that Royal Navy aircraft carriers are increasingly vulnerable to this kind of mixed threat environment with a low-cost swarm attack, exhausting missile defences and paving the way for a successful second wave of cruise and ballistic missiles.

Collaborative combat

Developments in the field of Collaborative Combat Aircraft (CCA) and their naval equivalent offer a crucial element of a solution. In the US, the Navy is basing its thinking on cheap, low-cost CCA they are willing to sacrifice to protect piloted assets. Such thinking applies equally well in the air defence environment.

It is possible to envisage a more comprehensive solution where the RAF Wedgetails are themselves escorted by uncrewed platforms presenting a similar electro-magnetic signature to the AEW platform. Creating a ratio of over (say) 20-30 disposable platforms to every one in the air would provide some resilience to the numerical assets that Russia typically deploys in simulated strike packages destined for the UKADR. These false targets would suffer the brunt of the losses, increasing the survivability of the E-7 platforms.

That being the case, as already noted, the number of Wedgetails appears to be below what might realistically be needed to sustain operations beyond the first few days of conflict. Given this, it makes sense to look at the development of CCA platforms that can perform a number of roles in both the air defence and naval defence environment, at the very least being able to mimic the crewed platforms they are escorting.

Similar arguments obviously apply to the protection of in-flight refuelling tankers as, arguably, they and the AEW assets are of equal value in maintaining the capability to defend UK airspace.

It is clear that the re-capitalisation of the current UK air defence is a matter of the highest priority for the SDR and for any resulting procurement programmes. In an uncertain international climate, where threats are proliferating in speed and geographical diversity, to not undertake a major overhaul of the current system would be a major failing of political leadership.

> “THE CURRENT STATE OF AFFAIRS IS CLEARLY NOT SUSTAINABLE OR SURVIVABLE BEYOND THE FIRST FEW HOURS OF A WIDER CONFLICT WITH RUSSIA

RAES HQ, LONDON
21-22 MAY 2025

ROYAL AERONAUTICAL SOCIETY

SAVE THE DATE: RAES FCAS SUMMIT 2025:
REDEFINING THE FUTURE OF AIR AND SPACE POWER

The RAeS Future Combat Air and Space Capabilities Summit (FCAS) returns for its third edition in May 2025!

The UK and global defence landscape is increasingly complex, with heightened geopolitical tensions and rapid technological advancement presenting both opportunities and challenges. As in previous years, the 2025 FCAS Summit will bring together global experts and leaders to explore these critical issues, informed by the UK's Strategic Defence Review (SDR), and to provide a strategic framework for UK defence and security policy.

During this two-day event, we will discuss defence capabilities and supply chain resilience; the UK's position as a global leader in defence aerospace; the imperative to maintain sovereign capabilities in key areas like aircraft design, development, and manufacturing; the need for strategic investment in emerging technologies; and the importance of fostering a robust defence industrial base. By addressing these priorities, the UK can safeguard its long-term security and prosperity in an ever-changing world.

By attending the Summit, participants will gain strategic insights, network with industry leaders, and explore cutting-edge technologies that will shape the future of air and space power. Scan the QR code on the right or visit **www.aerosociety.com/fcas2025** for more info.

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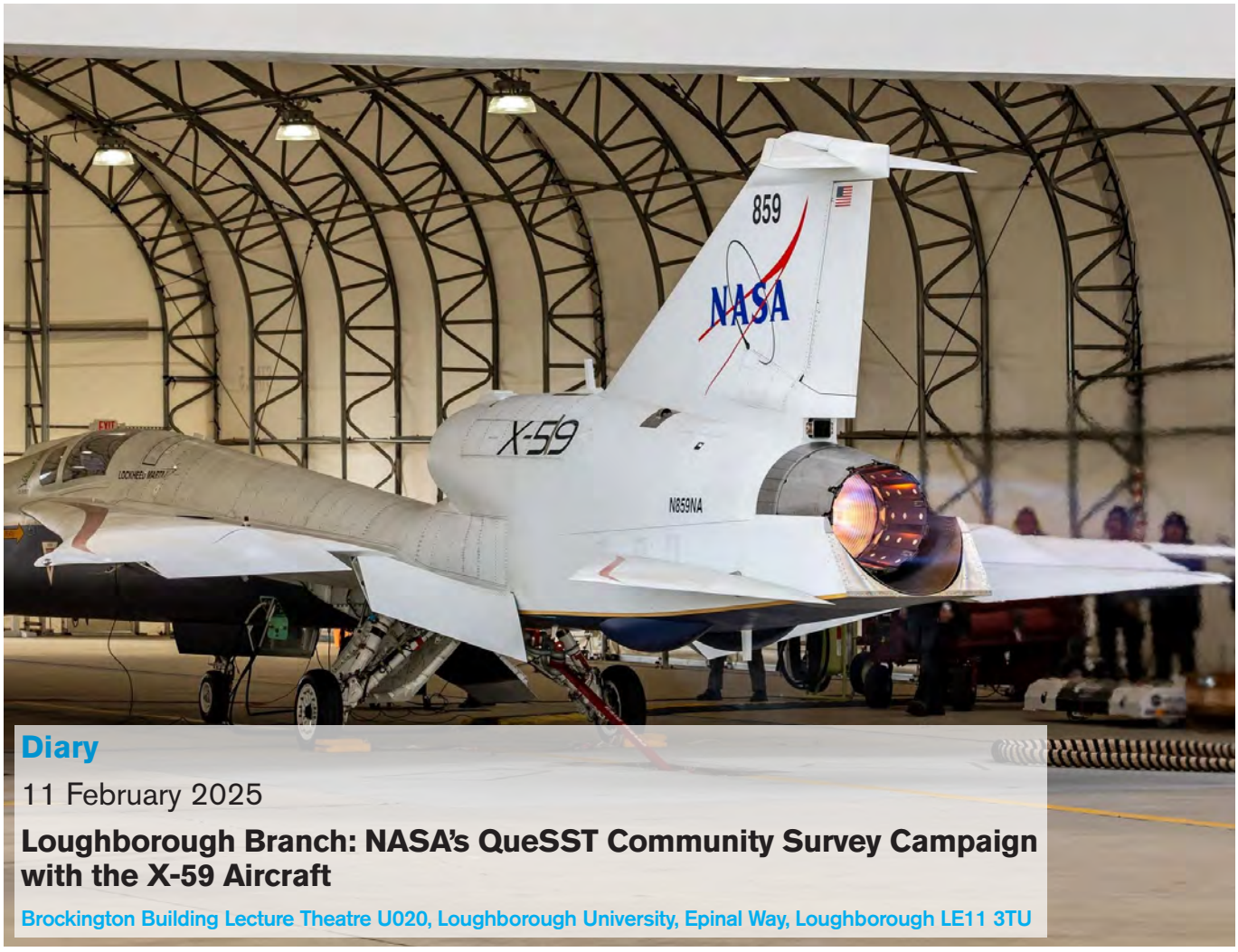

Diary

11 February 2025

Loughborough Branch: NASA's QueSST Community Survey Campaign with the X-59 Aircraft

Brockington Building Lecture Theatre U020, Loughborough University, Epinal Way, Loughborough LE11 3TU

NASA has carried out engine tests with the Lockheed Martin supplied X-59 QueSST as part of its research into ways of mitigating the noise aircraft make when they break the sound barrier. Dr Jonathan Rathsam, Senior Research Engineer at NASA, will address the Loughborough Branch about this project on 11 February. Lockheed Martin

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– From the President

"As I keep saying, the Society is you – it is its membership"

– From the Chief Executive Officer

"One of my personal overarching aims is to ensure that the Society remains a real home for aerospace, in its broadest sense, in the UK and globally."

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Message from RAeS

OUR PRESIDENT

David Chinn

> If you know of any individuals or teams who are worthy of medals and awards, please nominate them

▼ Scan the QR code to view a video of RAeS President, David Chinn reflecting on his presidential year so far.

It is already 2025! Well, where did that come from? From a Society point of view, 2024 ended on a high. In December, we saw the Medals and Awards ceremony at No.4 Hamilton Place, and it was a great privilege for me to present the awards. It is also quite humbling – not in a false modesty sort of way, but the fact that all the recipients were rewarded for something special. For me, recognising individuals' achievement is a great part of the Society. As I keep saying, the Society is you – it is its membership, so if you know of any individuals or teams who are worthy of medals and awards, please nominate them – the Medals and Awards team are always looking for high-quality nominations.

Back to my theme of Design, Build, Fly, which as you can imagine, I think about a lot. In my last column, I mentioned the key themes that came out of the conference, those of developing young professionals capable of working in a safety culture and a regulated environment from the beginning of their careers – for me these are distinguishing features of our business. On reflection, in building a Design, Build, Fly community, I think there is also the softer side which I find challenging to instil but it is something about the culture of doing practical aviation – not just talking about it but making it a normal, achievable thing to do. I think this is why I find the German *Akaflieg* movement so interesting and inspiring. Our friends and colleagues at the Light Aircraft Association, British Microlight Aircraft Association and British Glider Association live practical aviation on a day-to-day basis – which I personally find inspiring and one of my happy places is an airfield – big or small.

▼ RAeS President David Chinn, discusses his presidential year so far, reviewing the themes and highlighting key visits, as part of his New Year's video message on YouTube.

On the other hand, in the UK we have a great community of people who are happy working in the theoretical environment or indeed teaching practical skills at various levels, but without wanting to sound like a management consultant (I love them…) referring to the Society's charter, to me, if we start with the end in mind, it's about getting stuff flying – everything else is a means to this end, and so STEM, education and training should have this ultimate aim in mind, otherwise why are we doing it?

So is part of the Design, Build, Fly challenge, one of UK aviation culture itself and not just organisation? At my conference I think we had all the right people in the room to show that Design, Build, Fly is possible. As I keep saying, there appear to be no fundamental blockers. I am not denying the challenges of funding, time, resource, workspace etc, but – and I am open to challenge here – there is nothing fundamental in the UK environment to stop it happening. What I am less clear about is whether we have lost our collective nerve as a community. I am not suggesting taking undue risks in the safety sense, but I am talking about groups to get stuff flying. Why do I talk about culture? Well, in the *Akaflieg,* the norm is to have young people flying aeroplanes they have designed and built. I can see this culture emerging in the UK rocketry community which is great progress. But in the UK, at the moment, this mindset is not normal which, in my personal opinion, drives a glass half empty approach to seeing difficulties rather than possibilities.

So, as I move into the second half of my presidency, I am thinking hard about what the Society can do, or more specifically, help members to do; because it is our members that actually do things. How do I help people to get closer to my interpretation of the roots of the Society – furthering the art and science of aerospace? Is it such a hard thing? Or is it just a question of culture – the way we now do things – or do not? As I said at the conference you have my permission to go away and to design and build, so why not? Is the community constrained by real problems – possibly in some cases – or of ambition – or a set of self-limiting beliefs that it is all too difficult? I am not sure the Society's first gold medal winners had that mindset.

So would it not be great in a few years' time if we could see people at the Medals and Awards ceremony inspired by Design, Build, Fly? I can but hope! These could be individuals or groups, but for me it would be great having awards for people who actually get stuff flying. Remember, the Society's first gold medal went to the Wright Brothers. That says a lot, I think.

OUR CHIEF EXECUTIVE OFFICER

David Edwards

> I'd encourage you to make 2025 the year you visit your local branch if you've not yet done so

It is always pleasing to see Society members recognised in the New Year's Honours list, but this year we've seen not one, but two members who've served on Council appointed as Companions of the Order of the Bath (CB). Current member AM Paul Godfrey FRAeS, former Head of UK Space Command and now serving as Assistant Chief of the United States Space Force and AVM Simon Edwards, the RAF's Air Secretary and a former co-opted member of Council.

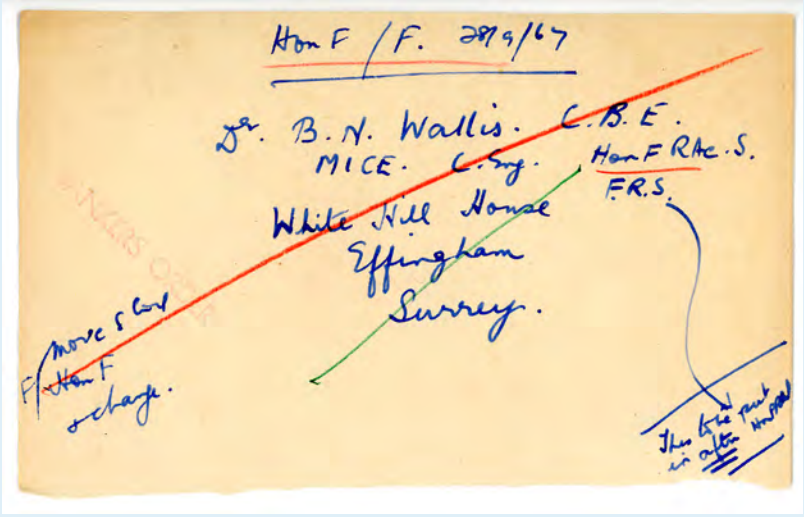
Warren East FRAeS, latterly Chief Executive of Rolls-Royce, one of the Society's consistent supporters, has been knighted, and we're pleased to hear of Wg Cdr Noel Rees MRAeS, mission commander of the flypast for the King's Coronation in 2023, being awarded an MBE. Our congratulations to them all, and all of those being recognised. The Society's Medals and Awards Committee, whose hard work ensures that we continue to recognise the very best in the world of aerospace, are also the Society's conduit for National Honours.

One of my personal overarching aims is to ensure that the Society remains a real home for aerospace, in its broadest sense, in the UK and globally. As we enter our 159th year I'm incredibly keen to ensure that we do that in a theoretical way, with our continued delivery of thought leadership, technical debate and independent analysis but also in a practical way with the use of our headquarters building at No.4 Hamilton Place as a broad home for our worlds. Going back through last year's use, we welcomed a cross-section of the community. We hosted the Civil Aviation Authority's first–ever Annual Address, which is scheduled to return in 2025. We also welcomed the International Civil Aviation Organization (ICAO) in the 80th year of the Chicago Convention to host their Civil Aviation Legal Advisers Forum, as well as holding the annual meeting of oneworld Alliance, in their 25th anniversary year, and hosted a number of representatives from the US legislature to meet our members, and other stakeholders. In December we were the venue for the announcement of the joint venture between BAE Systems, Leonardo and Japan Aircraft Industrial Enhancement Company for the next-generation GCAP aircraft programme. Alongside this, we've also been the venue for a number of less visible events, but still critical to the future of aerospace, whether it be on advancing regulation or the growing challenge of finding people.

The year 2025 has started in a similar vein, with the Society's Air Law Specialist Group welcoming Michael Gill, Director of Legal Affairs & External Relations Bureau at ICAO, to deliver the annual Beaumont Named Lecture, named for air law pioneer, Major Kenneth Beaumont who founded Beaumont & Son, now part of international law firm, Clyde & Co. Personally, Beaumont & Son were the first law firm I worked with in the airline world, so it's pleasing to see that name continue to be recognised. Thanks to Clyde & Co for their continued support of the Society. We've also been delighted to see the support for our Aerosociety Lates member events, to enhance the social side of membership – January was movie night where we showed the 1995 film *Apollo 13*, starring Tom Hanks, vividly brought to life by a Q&A session with Pat Norris FRAeS, who worked on the Apollo Moon landings programme.

We're pleased to confirm that Dr Brendan Nelson AO, President of Boeing Global, will be the Guest of Honour at the Society's Annual Banquet in May in London. He leads Boeing's global strategy and all corporate operations outside of the US and I'm sure attendees will be very interested to hear directly from him after a very challenging period in the company's history. We hope to see you there.

Along with a number of others, I was delighted to share my favourite item from the National Aerospace Library's collection at the Farnborough Branch's lecture recently, in a talk given by our Librarian and Archivist, Tony Pilmer FRAeS. It highlighted, as ever, the breadth of our collection there. I'm looking forward to attending the Cambridge branch for the 25th Sir Arthur Marshall Lecture at the end of this month – as always, please do take a look at the wide range of events being held throughout the Branch network all around the world, they are one of the bigger parts of our Society's membership engagement and fellowship. I'd encourage you to make 2025 the year you visit your local branch if you've not yet done so. Details are on the website.



▼ RAeS CEO, David Edwards selected Barnes Wallis' membership record as his favourite object at a lecture hosted by the Farnborough Branch about the history of aviation in a dozen(ish) objects.

RAeS\NAL

Society News

RAeS HEADQUARTERS

Dr Josef Aschbacher, Director General of the European Space Agency has been awarded the Geoffrey Pardoe Space Award in recognition of his contributions to the European space programme and the entire space sector. Originally anounced at the RAeS annual Medals and Awards Ceremony on 5 December 2024, it was presented in person at a later date by former RAeS President, Howard Nye FRAeS. Via Howard Nye

This year's Beaumont Lecture was delivered by Michael Gill FRAeS, who offered insightful analysis of successful legal instruments, like the Montreal Convention 1999, and emphasised the crucial role of industry collaboration and long-term strategic planning. Gill concluded by identifying potential areas for future development, including space law, advanced air mobility, and data protection. Jonathan Clare\RAeS

Professor George Leloudas
Vice Chair of the Air Law Group

AUSTRALIAN DIVISION RENEWS ENGINEERING CO-OPERATION

The Australian Division formally renew its commitment to collaborating with Engineers Australia in the advancement of excellence and high professional standards in the Australian aerospace industry with the signing of the new Co-operation Agreement in October 2024 (replacing the earlier agreement from 2004).

This agreement underscores the dedication of both organisations to continue their close collaboration, building upon individual strengths to benefit the greater Australian aerospace community as it looks toward the future.

Olga Hansen
RAeS Australia Division

◀ The RAeS' Australian Division President Emily Hughes FRAeS (left) signs the Co-operation Agreement with Romilly Madew (right), CEO of Engineers Australia. Olga Hansen

FROM THE ARCHIVE

With his brother Humphrey, Alliott Verdon Roe founded the AV Roe Aircraft Co on 1 January 1910 at Brownsfield Mill, Great Ancoats Street, Manchester. Later renamed Avro Aircraft, his most popular model, the Type 504, sold more than 8,300 units, mainly to the Royal Flying Corps and later to the RAF for use by training units. This Avro 504K served the RAF as E6765 but was retired after the Armistice and sold to George J Lusted, Shoreham for joyriding and aerial advertising. In July 1919 it was registered as G-EACA but after a year it was retired and in 1921 sold to Herbert Sykes. He named the aircraft *Psyche* and used it for providing pleasure flights at Maldon, Essex and Earlham Road in Norwich. However, on 28 September 1921 it was destroyed when it crashed shortly after take-off from Stag Lane, injuring Sykes. RAeS/NAL

Society News

RKP LECTURE AT THE WEYBRIDGE BRANCH

On Wednesday 27 November, the Weybridge Branch held the 69th RK Pierson Memorial Lecture at the Brooklands Museum. The 'RKP' was the Society's first named lecture, inaugurated in November 1952 when Sir Roy Fedden delivered his definitive paper on the life and work of Pierson, who had been Vickers' Chief Designer from 1917 until 1945, and designed 36 basic aircraft types, including the Vimy, Wellington and Viking, together with over 140 variants.

On this occasion, the lecture was delivered by Dr Emma Woolliams of the National Physical Laboratory. She is an acknowledged expert in the field of metrology and her lecture, 'Unleashing the Power of Satellites for Climate Action' described the principles of climate change and the difficulties encountered when taking and comparing measurements taken from space.

Woolliams began by explaining the importance of greenhouse gases to our survival, without which the global mean temperature would be somewhere around -18C, as it is on the Moon, instead of the much more comfortable average temperature of +15C we have when you average day and night, summer and winter all over the Earth. The problem is that when the quantity and effect of these gases increases even slightly, temperatures start to rise and as little as 1.5C appears to constitute a climate crisis. Woolliams performed a remarkable demonstration of the effect of this increase on various molecules which the audience found most amusing.

Some of the uses of satellite imaging and measurements were then described, together with some of the associated problems. Woolliams' team focuses on traceability, uncertainty analysis and comparison in satellite Earth observation and measurement. While measurements from space have many advantages over measurements on the surface, they can still be affected by degradation due to say, radiation, or even changes or decay in orbital parameters. Satellites fail, or their useful life is consumed, and so comparing results between satellites over many years requires the analytical tools and expertise that Emma and her team bring to bear.

This entertaining and informative lecture was followed by a lively Q&A session after which a vote of thanks was given by John Dunne, the Weybridge Branch Chairman. The branch hosted a dinner afterwards in the museum's Bluebird Room, and is grateful to BAE Systems for their ongoing support and to Brooklands Museum for hosting the event.

Alan Simmons FRAeS
Weybridge Branch

▲ Dr Emma Woolliams (right) pictured with Allan Winn (centre), President of the Weybridge Branch and Richard Gardner (left), founding trustee of the Farnborough Air Sciences Trust who was also a guest at dinner following the lecture.
Frank Rainsborough

▶ Dr Emma Woolliams of the National Physical Laboratory addressed the Weybridge Branch in its annual RK Pierson Memorial Lecture on 27 November 2024. Her talk covered the use of satellites in measuring climate change and the challenges inherent in this.
Frank Rainsborough

UPDATED SDR PAPER AVAILABLE

ROYAL AERONAUTICAL SOCIETY
STRATEGIC DEFENCE REVIEW (SDR) FOR GROWTH
RAeS SUBMISSION PAPER (with case studies)
December 2024

This is the RAeS' submission to the UK government's call for responses to the *Strategic Defence Review*. Scan the QR code to read the full briefing paper, which now includes case studies.

Book Reviews

WESTLAND'S CUTTING EDGE

Westland Aircraft and Rotorcraft: Secret Projects and Cutting Edge Technology

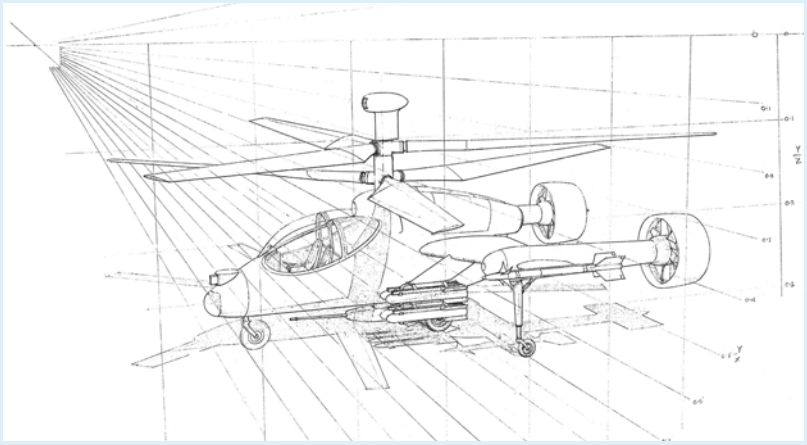
Jeremy Graham and Ron Smith

Tempest, 2024, 300pp, £39.99, available to RAeS Members via the National Aerospace Library

Although Westland was perhaps never really in the top league of British aircraft companies, compared to the likes of Avro or de Havilland, it produced some remarkable aircraft and achieved some notable feats – first aircraft to fly over Mount Everest and a world helicopter outright speed record, set at a time when the firm seemed to be at risk of going under, that still stands nearly 40 years on. It was surprisingly adventurous, perhaps at times too much so, with aircraft, such as the Dreadnought, that might have been a world leader but for its awful aerofoil design, and the series of tailless designs pioneered by JW Dunne.

The company's basic history has been well covered by books, such as Derek James' *Westland Aircraft*, but Jerry Graham and Ron Smith's book provides a fascinating behind-the-scenes view of a very vigorous and inventive company and a multitude of projects, many of which raise the 'What if…?' question. Both Graham and Smith played leading roles in many of the more recent ones, such as Lynx and Merlin. An immense amount of research has gone into this book and one of the most interesting periods covered is the post–WW2 years when the company was getting into helicopters but still heavily involved with fixed-wing aircraft. Who would have imagined that Westland had designed airliners, as well as some interesting jet fighters?

That decade also saw OLL Fitzwilliams joining the company as Chief Engineer Helicopters, having already worked with several of the early helicopter pioneers. Towards the end of his career he wrote a paper titled *Personal Transport for the Future* which ought to be required reading today for anyone thinking of investing in one of the eVTOL start-up companies. He sent a copy to RAE Farnborough with a rather modest covering letter in which he said that he understood that some of his colleagues regarded it as excessively tedious. It was certainly not light reading but it made it very clear that designing suitable air vehicles was the easy bit and the real problem was controlling hundreds or thousands of them in urban air space. Fifty years on *AEROSPACE* published an article titled 'The eVTOL collision conundrum', which clearly has still to be solved.



▲ A sketch of the proposed Westland Warrior, a potentially revolutionary design using co-axial lift offset rotor for the anti-armour role. Leonardo

◀ The book features several design drawings from Westland Helicopters, including this one for a three seat civil helicopter. Leonardo

A large section of the book is devoted to Westland's efforts to develop a dedicated armed attack helicopter, which seem to have been largely frustrated by the constantly changing minds of the potential customers. It was nice to see in a more recent issue of *AEROSPACE* that it has finally made it with the Leonardo AW249 [see *AEROSPACE* July 2024 Blueprint], which looks awfully like some of the things that Ron Smith was scheming 40 years ago!

I spent most of my career at RAE Farnborough paying regular visits to Yeovil and this book is a great reminder of what was and what might have been. My only regret about the book is that some of my RAE colleagues, like Phil Brotherhood and Doug Wilkinson, who contributed greatly to the success of the British Experimental Rotor Programme (BERP) do not get a mention, but perhaps BERP is worth a separate book of its own?

My one real criticism of the book is aimed not at the content but the production, which was presumably constrained to fit the format of Tempest's *Secret Projects* series. This has resulted in many of the drawings being very small and hard to view even with a magnifying glass. Nevertheless, the book is fascinating reading for anyone interested in British aviation – highly recommended.

Roger Cansdale FRAeS

Book Reviews

HISTORY OF HUDS

Through a Glass Brightly: A Story of the Development of the First Production Head-Up Display

Christopher Bartlett

Rochester Avionic Archives, 2024, 214 pages, £28.99 from the Aviation Bookshop, available to RAeS Members via the National Aerospace Library

This book documents the story of the world's first production Head–Up Display (HUD), which was designed for the Blackburn Buccaneer. The book starts by following the development of gunsights through to HUD systems, combining the technical aspects with company mergers and individuals. One point of interest in the book is that the earliest records for HUD technology can be traced back to a gunsight patent in 1901. The early gunsight products were developed for field guns and artillery; their application and development for aircraft were accelerated by the aerial conflict in WW1.

There is an in–depth description of the need for aircraft gunsights in WW1 with the ongoing technology development based on pilot needs in WW2. Gunsights then led to the first concepts for HUDs. The book integrates the maturing technology with the various manufacturing names, notably Elliott Flight Automation, along with Cintel; both of which are now part of BAE Systems.

Technical aspects of the HUD covered in the book include: cathode ray tubes, collimating optics, waveform generators and analogue/digital computing. Each of these are described from an emerging technology perspective. Operational challenges for pilots that were met with HUD technology include the need for sophisticated weapons and high-speed/low-level flights with very manoeuvrable aircraft.

The Buccaneer was an attack aircraft, in service with both the Royal Navy and the Royal Air Force, primarily in the low-level strike role. Developed in the 1950s, the Buccaneer's HUD was the world's first production system when it was introduced in the 1960s. HUD development continued beyond the Buccaneer for other military platforms, including the BAC TSR-2. Civil aircraft applications are also covered in the book, including the Short Belfast.

The book contains a good mix of technical, operational and historical content, together with some personal recollections from the author. The book has a comprehensive index and bibliography; there are very thorough references per individual chapters. Aside from the book review, the Rochester Avionic Archives website is well worth a visit rochesteravionicarchives.co.uk. The archives contain a large collection of avionic hardware, together with films, documents, videos, brochures and newspapers.

In conclusion, this is a fascinating book chronicling an untold area of aviation history.

David Wyatt

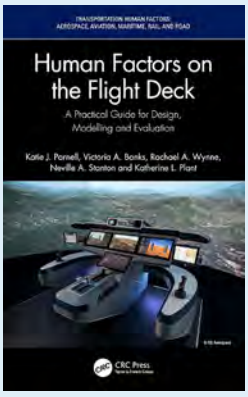
Head of Airworthiness (retired) in the Design Organisation at Gama Aviation.

HUMAN FACTORS

Human Factors on the Flight Deck: A Practical Guide for Design, Modelling and Evaluation

Katie J Parnell, Victoria A Banks, Rachael A Wynne, Neville A Stanton and Katherine L Plant

CRC Press, 186 pages, 2023, £89.99 in print and e-book, available to RAeS Members via the National Aerospace Library



Human factors covers a wide range of subjects; this book focuses on the flight deck for commercial airline pilots. The book provides a variety of methods and applications for optimising the interface between pilots and avionics systems in order to improve safety and performance.

The book starts with an introduction to human factors in aviation. It then describes the human factors approach to research and user-centred avionics design for the flight deck. This includes chapters covering the design process, design modelling and evaluation.

Examples are given in the book for the adverse events and incidents that have occurred due to poor design and a lack of awareness for airline pilots. These are presented to highlight the motivation for applying human factors to the aviation domain.

The book then gives typical reasons for undertaking a human factors study. These include testing if a hypothesis (research question) can be supported (or not), exploring the relationship between different variables, developing or validating models and evaluating features of design from single interfaces or products through to whole systems. It then details applications of different

Book Reviews

measures and methodologies that can facilitate the integration of human factors into the developmental life cycle of new avionic technologies.

A set of context-specific usability criteria is described in the book that can be used to guide future usability. It then overviews the design process, mapping the stages involved in the development, design, modelling and evaluation of new concepts for integration into the modern cockpit.

The book details what is required during the initial stage of the design process, defining new technological concepts and outlining their requirements. It then presents how end users, in this case airline pilots, can be heavily involved in the generation of design concepts. The book also discusses two key areas of modelling which are useful to the design process: engineering integration modelling and user behaviour modelling. It describes why design evaluation should be conducted throughout system development.

The book contains numerous human factors case study examples for avionic systems. One such case study that was of interest to the reviewer is for flight management systems (FMS), given my previous experience with these systems. This ranged from retrofitting the Sperry system onto British Airway's Boeing 747-100/200 fleet in the early 1980s, to product support engineering on the Boeing 737-300/400/500 and, finally, with an EASA Supplementary Type Certificate (STC) for a Learjet aircraft in the 2010s. The FMS case study in the book describes various human factor techniques used to quantify errors for two FMS functions: system initialisation and modifying a route during flight. The book identifies various error types such as data entry into the control display unit (CDU) and checking errors. The analysis then details the likelihood of errors and their criticality. The case study illustrates how CDU touchscreens and FMS connectivity could be used to reduce the frequency of errors.

Although this is a relatively short book of around 166 pages, it makes comprehensive use of approximately 200 references. The authors have a strong background in ergonomics, psychology and engineering (all are associated with the University of Southampton). The book will be useful for professionals, graduate students and academic researchers in the fields of aviation, human factors and ergonomics.

David Wyatt
Head of Airworthiness (retired) in the Design Organisation at Gama Aviation.

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Diary

EVENTS

10 February
RAeS Group Lecture: How an Aeroplane Really Flies
Ray Wilkinson
Royal Aeronautical Society HQ, No.4 Hamilton Place, London W1J 7BQ

10 February
Prestwick Branch: Aerobility – When Triumphs Trump the Trials
Neil Tucker and Harvey Matthewson
University of the West of Scotland, Ayr Campus, University Avenue, Ayr KA8 0SX

11 February
Sheffield Branch: Insights into Future Propulsion Technologies
James Hunt, Future Propulsion Lead, AMRC
The Diamond Building, University of Sheffield, 32 Leavygreave Road, Broomhall, Sheffield S3 7RD

11 February
Farnborough Branch: Voyager – Airbus to AirTanker
Geoff Winterbottom, FRAeS, Head of Voyager Capability Development, AirTanker
Farnborough College of Technology, Boundary Road, Farnborough GU14 6SB

11 February
Loughborough Branch: NASA's QueSST Community Survey Campaign with the X-59 Aircraft
Dr Jonathan Rathsam, Senior Research Engineer, NASA
Brockington Building Lecture Theatre U020, Loughborough University, Epinal Way, Loughborough LE11 3TU

12 February
Marham Branch: USN Aeromed/Physiologist
Marham Village Bowls Club, Coronation Playing Field, King's Lynn PE33 9JQ

12 February
Preston Branch AGM and Lecture: AI in Aerospace - Applications Today and the Potential for the Future
Venue TBC

13 February
Manchester Branch: #InspiringAviation – Is STEM Activity Useful for General Aviation?
Mike McLean MRAesS, Swift Technology Group Ltd
Theatre B, Roscoe Building, University of Manchester, Oxford Road, Manchester M13 9PL

18 February
Webinar – Preparing Your Aerospace Business for a Technology Project
Allen Reid, Director of GetSavi

18 February
Light Aircraft Design Online Teach-in
Dr Rashid Ali
Teams

19 February
Chester Branch: Apollo 11 Moon Landing
Robert Wills
Broughton Wings Club, CH4 0NQ

19 February
Weybridge Branch: The History of the Five Ark Royals
Rear Admiral David Snelson
Brooklands Museum Clubhouse, Brooklands Road, Weybridge, Surrey KT13 0QN

19 February
Brough Branch: NASA's Artemis Moon Programme – An Overview from the Side Lines
John Thatcher MRAeS
Cottingham Parks Golf and Leisure Club, Woodhill Way, Cottingham, East Yorkshire HU16 5SW (the lecture will also be available to watch online)

19 February
Cardiff Branch Ernest Willows Lecture: Lion Air Flight JT610/Boeing 737 Max 8 – A Loss of Control in Flight Accident Case Study
Mike Bromfield, Associate Professor/Flight Safety Researcher/ University of Birmingham and Captain Nils Jamieson, 737-800 Fleet Technical Pilot GASCo Regional Safety Officer
Building G, Pontypridd, University of South Wales – Treforest Campus, CF37 1DL

20 February
Cambridge Branch Sir Arthur Marshall Lecture: C-130 Hercules – First In, Last Out
Scott Bateman
Jesus College, West Court Forum Lecture Theatre, Jesus Lane, Cambridge CB5 8BL

20 February
Birmingham, Wolverhampton and Cosford Branch: Changing an Aircraft
Mr J A Benn MRAeS
RAF Museum Midlands Lecture Theatre, RAF Museum Midlands, Shifnal TF11 8UP

20 February
Mary Jackson Named Lecture 2025
Dr Gaitee Hussain, Head of Science Engagement and Oversights at the ESA
Virtual Event

20 February
RAeS Lecture: the Japan International Birdman Rally and the Future of Human Powered Flight in Britain
James Denton, and Max Polkinghorn
Royal Aeronautical Society HQ, No.4 Hamilton Place, London W1J 7BQ

25 February
Loughborough Branch: Westland Adopts, Learns and Perfects the Art and Science of Rotary Wing Flight
Jeremy Graham FRAeS, Retired Chief Engineer for AugustaWestland
Brockington Building Lecture Theatre U020, Loughborough University, Epinal Way, Loughborough LE11 3TU

For further information and booking, visit **aerosociety.com/events-calendar/**

ANNUAL MEETING FOR *THE AERONAUTICAL JOURNAL*

The annual Associate Editors' lunch meeting for *The Aeronautical Journal* (TAJ) took place on 12 December 2024. Editor-in-Chief, Professor Holger Babinsky welcomed some of the UK-based Associate Editors, and publishing partners, Cambridge University Press, to the RAeS HQ where he informed them that the TAJ is now approximately equal to the AIAA's *Journal of Aircraft* and approaching the *AIAA Journal* in terms of impact factor and has been elevated to the status of a 'Q2' (second quartile) engineering journal worldwide in an extremely competitive sector. Attendees were further cheered by news of TAJ drawing its largest ever number of submissions within a calendar year, surpassing 400 for the first time.

Wayne J Davis FRAeS
Production Manager – *The Aeronautical Journal*

New Member Spotlight

NEW MEMBER SPOTLIGHT

Name: Finley Vickers

Grade: Apprentice Affiliate

Age: 17

Location: Isle of Wight

Job title: Level 3 T Level in Engineering Student

What inspired you into aerospace? My family has a history of aviation with the Vickers Supermarine Spitfire and non-aviation related engineering, like the Vickers machine gun, the Vickers hardness test and many other ventures. Growing up, my dad always ran out of our garage when fixing cars if he heard a Spitfire, and over the years, he has passed on his knowledge of Vickers' engineering and I researched it as best I could and it was interesting to learn, which then sparked an interest in aviation, specifically things like fighter jets and Spitfires.

What's the best thing about your current role? The vast amount of different subjects we learn, such as computer-aided design/computer-aided manufacturing, physics and maths.

What made you join the RAeS? I thought it would be interesting to keep an insight into the aviation industry and what is happening.

What do you hope to get out of your membership and registration with the RAeS? To widen my knowledge and keep up to date with everything going on and to pick up information which is shared within the RAeS.

What three items would you take with you to the Space Station? Snickers, Lego and something to listen to music on.

What's your favourite aircraft? The North American P-51 Mustang or the Vickers Supermarine Spitfire of course!

Who is your biggest inspiration? My dad (Big Sid). He is the man that started my interest in engineering in general.

Piece of advice for someone trying to enter your field? Make sure you know what you want to do and gain a basic knowledge of engineering before you start. It can be quite tricky at times so having a good foundation of knowledge can seriously help.

Do you have Apprentices working in your company?

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Apprentices can join the RAeS as an Apprentice Affiliate for free

Learn through our extensive range of lectures, conferences, publications and make use of the National Aerospace Library

Develop with volunteering opportunities and access to Aeroversity, our online professional development tool.

Recognition through professional registration. Start learning about routes to registration as an EngTech, IEng or CEng registered engineer

Organise a membership briefing at your company

Contact us: membership@aerosociety.com or call +44 (0)20 7670 4365

Elections

FELLOWS

Christopher Brehm
Nicholas Brown
Patrick Shea-Simonds
Stuart Simpson

MEMBERS

Ebenezer Adebayo
Saif Almutairi
Deelan Jethwa
Vidyasagar Kotha
Rajat Pattepur

ASSOCIATE MEMBERS

Mohammad Saleem Khan
Kristian Kolb
Stefano Pezzotta
Scott Russell
Kasigan Appavou

ASSOCIATES

Joshua Howard
Ian Shaw

E-ASSOCIATES

Oliver Barnby
David Bosmans
Ceri Brown
Dan-Victor Dirgau
Ruchintha Perera
Daniel Pusztai
Ayman Raymode
Rania Regaieg
Tanveer Talokder

AFFILIATES

Joshua Attard
Paul Broadley
Jacques Delabye
Bhuvan Kashetty
SeyyedAbdolhojjat Moghadasnian

STUDENT AFFILIATES

Kasigan Appavou
Ewan Gribbin

WITH REGRET

The Royal Aeronautical Society announces, with regret, the death of the following members:

Leonard Hart-Smith FRAeS 85
Ian Larby MRAeS 86
Brian Osbon AMRAeS 85
John Ward FRAeS 80

COULD YOU BE AN ALTA MENTOR?

Since its launch on International Women's Day 2019, the alta mentoring platform has grown to a membership of 750 mentors and mentees and 15 supporting Corporate Partners, including Boeing (UK), KLM (UK) and British Airways. During this time, the alta Steering Group at the Royal Aeronautical Society has overseen the strategic direction and development of alta, including the launch of a new website (altamentoring.com) and set of training modules.

Based upon a model where successful women reach out and support less experienced women, alta empowers them through mentoring. It is 'designed by women for women,' creating a circle of positive benefits for individual women and their organisations. It was designed to support women only as they are so poorly represented throughout the industry in key roles and senior positions.

As demand for alta increases and more supporting partners join us, we now need to recruit more mentors so that we can reach out to more women across the aviation and aerospace industry. If you are a woman in, or affiliated to, the industry, would like to join a community of like-minded women and become a mentor for an award-winning mentoring platform, please read on!

At alta we believe that mentoring can be empowering and developmental for mentors, as well as mentees. Whether you are an experienced mentor or mentoring for the first time, we have developed a series of training modules that are available on our website and mentoring platform. These modules provide an overview of alta – what makes it different to other mentoring programmes, the career barriers women face and how to address these, and how to get started with alta. Our most recent module (launched in October 2024) covers the complex question of

intersectionality – recognising that all women are different and encouraging us to think about how we can value these differences through mentoring.

Joining alta is simple and free of charge. You can sign up to the alta mentoring platform directly from the website where you will also find comprehensive mentor training, including how to get started and hints and tips for an effective mentoring relationship. When you sign up, you will be asked to answer a series of matching questions which will ensure the right mentor/mentee match via a matching algorithm. This is conducted via the secure alta platform.

Through mentoring both mentors and mentees can feel more valued and empowered to progress their careers and to work in what feels like a more supportive environment. The alta mentoring platform transcends organisational and geographical boundaries, making mentoring support more widely and easily accessible to women across the industry.

Become an alta mentor today, join the alta community and help us to reach out to more women!

Professor Sue Durbin
alta Steering Group Chair

Visit www.altamentoring.com to find out more!

The Last Word

COMMENTARY FROM

Professor Keith Hayward
FRAeS

"I'm from Warton, and here to help"

"I'm from Warton, and here to help" was apocryphally the most feared offer to others in the British aerospace industry.

The rise of English Electric and its famed design and development centre out on the Fylde in Lancashire was one of the major events of post-war UK aerospace history. A new entrant in an arguably already overcrowded industry, English Electric was an ideal model for a modern aerospace company. Being part of a well-funded conglomerate, affording world-class facilities, especially for R&D, set it apart from most of its British contemporaries. Led initially by the brilliant W E W 'Teddy' Petter, and subsequently by the young and equally able 'Freddie' Page, the Warton site developed two of the most important and advanced military aircraft of the day – the Canberra and the Lightning.

Meanwhile, up the River Ribble was English Electric's equally famed production centre in Samlesbury. However, there was considerable and dysfunctional tension between the bright young men at Warton aerodrome and the practical chaps led by the formidable 'Shef' Sheffield. Never an easy relationship, its rancour helped to undermine Warton's case for leadership of the TSR.2 – but the fallout from its 1965 cancellation created a single BAC military design centre.

Along with Rolls-Royce, Warton was viewed by the then government as an asset to be defended when key collaborative projects collapsed. All's well that ends well though and the Panavia MRCA/Tornado and then the Eurofighter/Typhoon were the twin phoenixes ensuring survival and then prosperity for Warton and Samlesbury.

> "ALONG WITH ROLLS-ROYCE, WARTON WAS VIEWED BY THE THEN GOVERNMENT AS AN ASSET TO BE DEFENDED WHEN KEY COLLABORATIVE PROJECTS COLLAPSED

World-class production and development

These days, there is less tension between Warton and the Samlesbury production centre. The latter is well regarded as one of the most efficient units of its kind, a pioneer of the 'lean manufacturing' philosophy applied to aerospace – a direct legacy from the old British Aerospace's connection with Honda-Rover in the 1990s. However, according to a recent report in the *Financial Times*, BAE Systems' production centre, or more accurately, its final assembly skills, are now in danger of atrophy, caused by a decline in RAF Typhoon orders, despite follow-on orders from Italy (24 aircraft) and Spain (25 aircraft) late last year. There is still the not insignificant chunk of business related to the F-35 and BAE Systems' share of Typhoon components shipped out for assembly by its partners..

Warton seems to be better placed, buoyed by developing the Tempest, but a more serious issue would be if Typhoon orders ended before Tempest production comes online, with 6,000 skilled jobs at stake.

Boeing's woes, similar but different

Boeing faces a mirror image of BAE Systems' problem in that its production capabilities (once quality issues have been sorted out) will be brim full of work for the foreseeable future. The issue here is that Seattle is losing development engineers to the likes of SpaceX, which is offering more advanced and challenging new projects to work on. Boeing has no definitive plans yet for a new airliner to provide work for its design and development staff and, combined with a more ruthless 'hire and fire' churn responding to peaks and troughs in demand, luring them back might prove tricky.

Boeing has no quick answer to this problem, short of launching an all-new – and presumably very expensive – airliner. According to BAE Systems' unions, the RAF should step in to fill the Typhoon gap with a top-up order, but, if future defence budgets focus on new uncrewed concepts and orders for the F-35B, there may be some difficult years ahead up in the northwest of England.

ROYAL AERONAUTICAL SOCIETY

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Membership fees were due by 1 January 2025

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